

IMPACT OF TECHNOLOGICAL TRENDS
ON
CITY PLANNING

by
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of the Requirements for the Degree

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Signature of Author

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LETTER OF SUBMITTAL

The Graduate House
Massachusetts Institute of Technology
Cambridge, Massachusetts
January 17, 1947

Professor Frederick J. Adams
In Charge of the Course in
City and Regional Planning
School of Architecture and Planning
Massachusetts Institute of Technology
Cambridge, Massachusetts

Dear Professor Adams:

In partial fulfillment of the requirements for the
degree of Master in City Planning, I hereby submit
my thesis entitled: " The Impact of Technological
Trends on City Planning. "

Sincerely yours,



Roger Willcox

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PART I; PREFACE

EACH passing year finds our cities facing more and more complex problems. All kinds of problems. Central areas are plagued by growing traffic jams and parking tieups, growing blighted areas and declining tax bases. Suburban areas sprawl wastefully ever-further over the countryside; creating new needs for roads, schools, parks, utilities, police. And tremendous housing shortages are with us for years to come, postponing consideration of already existing crises.

We American city planners therefore face an ever more difficult task. If we hope to do justice to our profession we must learn new ways of making our cities better to live in.

* * * * *

Technological developments offer many interesting possibilities for city planning. Yet no general studies appear to exist which indicate how technological progress will affect city planning tomorrow. Books have been written on the effects of specific inventions such as the automobile, radio and airplane; but little has been written towards integrating the whole pattern of technological progress with city planning progress.

This little study attempts such an integration. It begins with a brief estimate of technological impact on past city development. It then presents a 'way of understanding' future developments in the fields of industrial science. Emphasis is placed on indicating how technology can be best used to help solve problems facing American city planners.

* * * * *

I wish to express my appreciation to the members of the School of Architecture and Planning staff at M.I.T., and to Professor Frederick J. Adams in particular, for a great deal of direct and indirect guidance; and to my friend William Blitzer and my fiancée Elsie van Bueren for their help.

SECTION 1. BACKGROUND

OUR cities are chaotic -- so say many outspoken critics. By this they mean that our city patterns of development are bordering on utter disorder, almost reaching the point of stifling the human race ! One such critic, after reviewing the many evil features of our cities, concludes

Insanity varies with the density of population. We learn that the birth-rate in large cities is suicidal hence we are compelled to assume that if the "modern" city were taken as the norm, the norm would also consist of an extinct human race.¹

The detailed arguments of these critics throw considerable light on the role of technology in the evolution of cities. Therefore as background for this study of the 'impact of technology', a brief summary is presented of what seem to be their key arguments and key conclusions. Benton MacKaye, Patrick Geddes, Lewis Mumford, Elmer Peterson and others whose works are cited in the bibliography, provide fuller statements.

* * * * *

A. CRITICS' ARGUMENTS

When we boil down the problem of what is wrong with our

¹ Peterson, Elmer T., (editor) Cities Are Abnormal, Norman, Oklahoma. University of Oklahoma Press. 1946. p. 23.

cities, we find two major kinds of factors which influence city development. The first kind make up what we can call the 'environment' of cities, the general background of cultural development within which cities are formed. Social, political and economic factors such as wars, depressions, plagues, class and race riots --- all these have effects on the form of cities. These 'environmental' factors have been operating in one form or another throughout recorded history. And relatively well planned cities were created in past centuries in spite of all such obstacles. ¹

The second group includes those specific factors which appear to have caused EXCESSIVE disorder in our 'modern' cities. These factors line up on two sides of a battle between the 'irresistable force and the immovable objects'. The immovable objects are created by (a) the durability of city structures and (b) the unplanned character of city evolution. The irresistable force is primarily a mixture of (c) tremendous expansion of city populations and (d) technological innovations -- new inventions.

It is this second group of factors which we will find

¹ For examples, see Sharp, Thomas, Town Planning, London. Penguin Books. 1945. p. 12 ff, on the English tradition of fine town and country building --- before the industrial revolution. Also see the books by Mumford and Geddes.

of interest here.

The first two factors concern the character of present-day cities. They appear as key "existing conditions" which the forces of new developments have had to change.

(1) DURABILITY OF CITY STRUCTURES. Cities have traditionally been man's most durable goods. They are developed over hundreds of years, embodying man's most exquisite skill and loving care. Every device known to man is used to perpetuate what he has built ! Thus cities, once they are built, are exceedingly hard to change.

Furthermore, Lewis Mumford in speaking of modern cities, points out that as cities grow more complex they become even harder to change:

The more the energies of a community become immobilized in ponderous material structures, the less ready is it to adjust itself to new emergencies and to take advantage of new possibilities. A two-story building with shallow foundations may be easily torn down if a different type of structure is needed. But a twenty story building has a deep foundation, elaborate mechanical equipment, an expensive superstructure: it is not easily demolished as a physical structure, still less easily as a credit structure.....Every part of the community's shell and equipment presents the same dilemma.¹

Thus ever-increasing durability of city form may be considered a basic characteristic of our present-day cities.

¹ Mumford, Lewis. The Culture of Cities. New York. Harcourt Brace & Co., 1938. P. 440.

(2) CITY EVOLUTION WITHOUT OVERALL PLAN. The effect of this increasing rigidity in city structure is increased by the way in which our cities are developed. Patrick Geddes, the 'father of town planning', emphasized this second crucial factor while writing about the evolution of cities and about London in particular:

This octopus of London, polypus rather, is something curious exceedingly, a vast irregular growth without previous parallel in the world of life -- perhaps likeliest to the spreadings of a great coral reef. Like this, it has a stoney skeleton, and living polypes -- call it, then, a "Man-reef" if you will

Reflection on this unusual simile discloses a deal of common sense behind it. For our modern cities, like coral reefs, are constructed not in accord with any overall plan, but rather in accord with the summation of the individual activities of millions of people, each one acting much as he or she wishes !

With a few notable exceptions this 'man-reef' formation has been typical of cities built by man. A few features of the average city were created by common effort: perhaps the protective wall and the dominating market, church, and castle sites if the city be an old one; the main street; a harbor breakwater. But the remaining features of the city are often created in the images of such accidents as cowpaths, filled-in drainage ditches, and

¹ Geddes, Patrick. Cities in Evolution. London, Williams and Novgate, 1915. p. 26.

more recently, the engineer's graph paper. These accidents of city plan are then perpetuated and extended by further building and rebuilding. And our cities just "grow" -- like coral reefs !

In passing we should note that cities which grew up before the industrial revolution were able to achieve a vital harmony through hundreds of years of slow growth and adjustment. The vital factors in their formation changed but slowly. Transportation on foot, by wagons, by boat; building materials standardized through centuries as to type at least; relatively small and stable populations --- the forces of rapid change scarcely existed and many cities grew gradually and gracefully, adapting themselves to the needs of their citizens.

In fact many European cities were so firmly formed before the industrial revolution that they simply could not be changed without complete destruction and rebuilding. Unless bombed out of existence they remained in a sort of living-fossil form. Ironical comparisons have been made between some of these old "quaint" cities and the "modern" metropolis¹,

* * * * *

Opposed to these two stabilizing forces are those elements

¹ Thornton, Jesse. E. (compiler). Science and Social Change. Washington D. C., Brookings Institution, 1939. p. 123, 136. Also Randall, John Herman Jr., Our Changing Civilization. Stokes. 1934.

of unceasing change and growth. These forces of change beat against the rigid structures of older cities and mold new developments in the image of chaos, without regard for the finer human values.

(3) TREMENDOUS EXPANSION OF CITY POPULATIONS. After the industrial revolution a group of new forces began to affect city patterns. Whereas older cities grew over hundreds of years, the new cities of the industrial revolution sprang up in a single generation.

In our own country where no older cities existed, the one factor of rapid growth alone accounts for much of our present city problems. The extent of this growth is illustrated by the accompanying data regarding cities in the United States. In the last 100 years the percent of American people living in cities of over 25,000 population has risen from 5.5 per cent to over 40 per cent ! And 12 per cent of our people live in the five largest cities today. It would have been miraculous if these cities were well planned; since no traditions of such rapid city structure existed. Ebenezer Howard, Patrick Geddes and other builders of the present city planning movement only began to win supporters in the 20th Century.

In fact it might be argued that this factor of tremendous growth accounts for ALL the problems of modern city planning.

GROWTH OF THE LARGEST CITIES IN THE UNITED STATES:

(2) by 50 year periods, 1790 to 1940, from U.S. Census, 1st Series, Population, 16th Census, U.S. Summary. Washington, D.C. Department of Commerce. 1942. Tables # 10, 12, 18.

(1) THE FIVE LARGEST U.S. CITIES -- Populations given in thousands.

1790		1840		1890		1940	
City	Pop.	City	Pop.	City	Pop.	City	Pop.
N.Y.C. ^a	49	N.Y.C.	391	N.Y.C.	2,507	N.Y.C.	7,455
Phila.	29	Baltimore	102	Chicago	1,100	Chicago	3,397
Boston	18	New Orleans	102	Phila.	1,047	Phila.	1,931
Baltimore	14	Phila.	94	St. Louis	452	Detroit	1,623
Providence	6	Boston	93	Boston	448	Los Ang.	1,504
TOTAL:	116		782		5,554		15,910
U.S. Pop.	3,929		17,069		62,948		131,669

a- Includes all areas incorporated in the present 5 boros of New York City.

(2) NUMBERS OF LARGEST U.S. CITIES BY SIZE CLASSES, and PERCENTAGES OF TOTAL POPULATION IN U.S.A. REPRESENTED

Subject and Class of Places	1790	1840	1890	1940
(a) Number of places having				
25,000 persons or more.....	2	12	124	412
100,000 persons or more.....	-	3	28	92
1,000,000 persons or more.....	-	-	3	5
(b) Per cent of <u>total population</u> in places				
25,000 persons or more.....	1.6	5.5	22.2	40.1
100,000 persons or more.....	-	3.0	15.4	28.9
1,000,000 persons or more.....	-	-	5.8	12.1
(c) Per cent in 5 largest places (table #1)	2.9	4.3	8.8	12.1

However such an argument forgets that the huge increase in population, and the even more significant increase in percentage of people living in cities, BOTH can be explained ONLY in terms of the economic, scientific and technical advances of the industrial revolution. For without sanitation improvements, transportation improvements, and increases in productive power, most of the cities of today could not have been peopled and fed, let alone constructed. The factor of plagues alone, caused by bad sanitation and other unhealthy conditions, would have kept down city sizes in the 19th Century just as it did in the 16th Century.¹

Therefore many commentators have concluded that the factor of tremendous increase in cities and city populations cannot be considered more than a contributing factor in present city problems.

(4) TECHNOLOGICAL INNOVATIONS -- NEW INVENTIONS.

Patrick Geddes, Benton MacKaye, Lewis Mumford, William Ogburn and others have pointed out that the special impact of a thousand technological innovations turned the confusion which naturally resulted from enlarging old cities into chaos.

Some have even argued that any one of several major

¹ Peterson, op. cit. p 96. Mumford, Culture of Cities, op. cit. p 42-44.

inventions would have created chaos in our larger cities. A few of the more important NEW elements in city creation which have particularly destructive effect are: the railroads, the use of coal as a fuel, the factory system, the introduction of elevators and skyscrapers, the development of standardized houses, the street transportation systems, the automobile.

Illustrations of how these new factors hurt cities and of how their effects can be overcome, will be the subject of this study. At this point only some general observations appear useful.

First, these factors of technological progress which have helped bring disorder to our cities are collectively known as the backbone of the industrial revolution. And our cities are not the only part of our society which has been roughly handled during the course of this continuing upheaval in our mode of production.

William Ogburn has popularized the concept of "cultural lag" to signify the growing gap between our technological advances and our more slowly moving social order.¹

Second, within the range of possibilities of new inventions there are potentialities for both good and evil.

¹ Ogburn, W.F. and Nimkoff, M.F., Sociology. Cambridge, Mass., Houghton Mifflin Co., 1940. p. 886.

The potentialities for good must be stressed if we are to have good city planning. And this will require a far-greater measure of control than we have ever exercised before.

In summary, the special characteristics of cities which resist changing conditions have thus far 'won their battle'. A rational approach to the problems of technological change has been thwarted by the unholy combination of rigid city patterns plus completely decentralized 'planning' for city growth. The positive possibilities of technology have been ignored. We continue to build cities like coral reefs.

* * * * *

B. CRITICS' CONCLUSIONS

Some critics go far beyond the mere observation that technological change has been thwarted by rigid city forms and lack of centralized city planning. Some acute observers are prepared to defend the view that an entirely 'new world' of city life has been created and has ENGULFED an overwhelming majority of people living in the Western World. After noting that a "rootless, aimless, profoundly disharmonized environment has replaced the indigenous (traditional and natural one for human beings)", Benton MacKaye explains

This new world is the metropolitan world. It is "a world without a country". Its reactions are born not of nature's soil, but of artificiality; they are reverse to the reactions of the natural normal sphere. Instead of means being adapted to achieve ends, the ends are distorted to fit established means; in lieu of industry being made to achieve culture, culture is being made to echo the intonations of industry¹

And twenty years earlier Patrick Geddes had summed up his view of our industrialized metropolis by saying:

Slum, semi-slum, Super-slum -- to this has come
the Evolution of Cities ²

Perhaps the logical extreme of this school of thought in America is portrayed by a group of social scientists who collaborated in a recent symposium called Cities Are Abnormal ³. By ABNORMAL they meant that the metropolitan cities of today are NOT NORMAL for human living. Instead of fulfilling human expectations, the cities of today insidiously destroy life and hopes. This section opened with a sample of their editor's conclusions -- "if the 'modern' city were taken as the norm, the norm would also consist of an extinct human race." The contributors to this symposium carry this theme into their respective fields: biology, health, industry, agriculture, architecture, population research, sociology, government. Every field is seen echoing back an indictment ^{cf. Webster's for city}

¹ MacKaye, Benton; The New Exploration, An Introduction to Regional Planning. New York, Harcourt Brace & Co., 1928. p. 71.

² Geddes, op. cit., p. 129.

³ Peterson, op. cit.

of our present urban environment.¹

However it is worth emphasizing that all but the most rabid critics of our "rootless, aimless, profoundly disharmonized (urban) environment" are still able to see some vital virtues in city living. They recognize that our civilization has been cradled in cities. They recognize that the political and social intercourse of cities provide the driving force of our cultural development. They recognize that there are people who by free choice WANT to live in cities for myriad reasons.

It is NOT CITIES in the abstract that are usually criticized, it is "MODERN" CHAOTIC CITY DEVELOPMENTS. In

¹ Two examples of conclusions from the medical field may prove illuminating. Dr. Jonathan Forman, editor of the Ohio State Medical Journal:

Parenthood:

It is almost impossible for a woman to be a good and wise mother in the city..... In the city there are so many dangers that a child needs relentless watching by day and by night. Thus in his early years the mother sensitizes the child's mind through overprotectionproceeds to protect her child from making decisionsthis mother has overreacted to her situation -- her small family, her cramped living quarters, and the artificiality of the urban life which engulfs her. (p.112)

Marriage:

in 1940 cities lacked 26% of maintaining their population (p 98)....some 30% of urban women are childless throughout life, 20% more have only one child (p. 72).....

Family life attempted in cramped quarters "with never a room to call one's own," calls for a capacity for social adjustment, mental poise, and tolerance which few people possess. Consequently there are about twice as many divorces in cities as among rural people.... result of many forces -- lack of home life, irritability, financial strain, ambition, malnutrition, and neuroses. (p. 98).

the pages that follow this conclusion of others is assumed correct.

* * * * *

C. WHERE WE BEGIN -- BASIC ASSUMPTIONS. We begin therefore, with a recognition that existing city development presents objectionable features that are NOT merely modern forms of ancient problems. Superimposed on the social and political problems of all times has NOW BEEN PLACED a tremendous NEW set of problems caused in large part by technological developments misused in building larger cities and new urban regions.

It follows therefore, that NEW CITY FORMS are required; new forms that will properly utilize the new technological forces in providing really desirable urban living conditions.

Implicit in the recognition that NEW CITY FORMS ARE REQUIRED is the realization that some NEW kinds of social control are also needed to confine the new forces. The old method of permitting cities to grow as the summation of millions of individual efforts must be modified. An Atomic Development Authority in the United States was created to control a devastating new source of power and destruction in the public interest. New control agencies are likewise needed for the new factors of city growth which also have proven devastating to human life and human hopes.

Finally, as this is a study of technical potentialities and requirements, only passing consideration can be given to political angles. However it is realized that better city planning can only come through better political action. Therefore the author has taken the liberty of indicating possible objectives for political action which will make the most out of technological progress for city planning.

PART II: TOWARDS A METHOD OF UNDERSTANDING

THE preceding pages dealt primarily with effects of PAST technological trends on PAST and PRESENT city planning efforts. The conclusion of others that the general effect has been 'bad' is accepted.

From now on we deal with how to understand technological trends better, particularly their FUTURE impact on city planning. Three questions summarize the problems posed:

- (1) What are the technological trends?
- (2) What is good city planning?
- (3) What is the best way to combine technology and city planning?

In Part II each of these questions will be analyzed in a general way. In Part III they will each be illustrated and partly answered.

The first question: What are technological trends? asks simply for an understanding of scientific possibilities. Its answer will indicate the MEANS at our disposal for good city planning. Since this study of MEANS will provide only basic, preliminary considerations for the planner, it shall be referred to as the "grammar-school" level of understanding the future impact of technological trends on city planning.

The second question: What is good city planning?

recognizes that mere continuation of existing trends is bad. We must not necessarily think in terms of bigger and better highways, bigger and better factories, bigger and better cities. The ideas of "bigger and better" are neither synonymous, nor necessarily desirable for city/planning. Such thinking forgets the fundamental postulate of city planning: we plan to make cities better places for humans to live in.

The answer to this second question will indicate the ENDS or OBJECTIVES to which good city planning efforts should be directed. Since a proper study of objectives for city planning involves philosophical and sociological questions of a complex nature, involves the concept of a 'technology of city planning'; this study of ENDS shall be referred to as the "high-school" level of understanding the future impact of technological trends on city planning.

The third question: What is the best way to combine technology and city planning? is the most interesting and most complicated question of the three. It will be partly answered by indicating ways of adjusting technological MEANS at our disposal to reach the ENDS in view: human needs as expressed in good city planning. It can only be completely answered to the extent that technology and planning ARE ACTUALLY MERGED in successful city planning creations. This highest level of understanding shall be referred to as the "university" level".

SECTION 2. THE "GRAMMAR-SCHOOL" LEVEL (Technological Means)

WE live in an 'age of science'. Every day new developments occur. To master the real meaning of technological achievements, and then to keep abreast of the new developments is no simple undertaking. Certainly within the limits of this short study we can expect only an outline of basic concepts necessary for a elementary 'understanding'.

The following pages present a summary of the meaning of technological progress, compiled from secondary sources. Points covered include:

- A. Basic Definitions
- B. Long term trends
 - (1) in technology
 - (2) in physical sciences
- C. Short term trends
 - (1) the role of inventions
 - (2) the role of inventors
 - (3) complex nature of a major invention
- D. A frame of reference for trends and inventions
- E. Prediction today
 - (1) short-term prediction of trends and inventions
 - (2) long-term prediction of scientific advance

The bibliography at the end of this study lists major works consulted.¹

* * * * *

A. DEFINITIONS

Science as used in this study will be taken to mean 'any

¹ Professor John T. Burchard, present chief of libraries at M.I.T., has indicated that World War II experience in technology has produced voluminous 'current' literature which should also be investigated.

department of systematized knowledge, or in general, systematized knowledge'. Technology is defined as industrial science, or applied science in general.

Technological trends are created simply by the step by step advances in the fields of applied scientific endeavor. Since the sciences of today are continually adding to their wealth of systematized knowledge, technological trends are always moving forward into the dimly lit realms of future invention and future scientific discovery. An inventory of technological trends is thus a chart of applied science frontiers.

Here a major source of misunderstanding must be cleared up. Numerous attempts have been made to show that technological trends have had a decisive and direct influence on the progress of mankind ! There is no question that we have seen progress in technological trends since the days of cave men. But there is reason to doubt that man has progressed in similar steady fashion in other fields -- witness the historical development of bigger and bigger wars and depressions.

Thus the conclusions of this study must always be subject to the ways in which members of our world use the forces at their disposal. Technological trends not only FAIL TO DIRECT HUMAN PROGRESS, they have often been used

to destroy human hopes for a better world.

Further definitions and distinctions will be made from time to time. Here we will conclude by noting that, as we have defined the terms (from Webster), there CAN be a science of city planning. And there can likewise be a technology, or body of applied science, of city planning!

* * * * *

B. LONG TERM TRENDS

In considering technological trends an immediate distinction must be made between long-term and short-term trends.

Briefly, long-term trends are outlined by history. Short term trends are simply the day-to-day evolution of technology through successive inventions. The continuous improvement in ways of transportation as a whole is a long-term trend. The steps in the rise and decline of street railways and the automobile form short-term trends.

(1) LONG-TERM TRENDS IN TECHNOLOGY. Historically, the long-term aspects of technological evolution began to emerge with the realization that scientific progress was definitely being made and would continue to be made in the future. Over 300 years ago long-term trends in technology began to appear. And in 1627 Francis Bacon's The New Atlantis placed science and inventions as the chief glory,

and inventors as the chief heroes of the State. Francis Bacon really understood the possibilities of continued scientific progress. "Nothing that we do or practice today would have surprised him".¹ This seems to be the beginning of a NEW concept of inevitable scientific progress, the core of long-term trends in technology.

An outstanding contribution of Lewis Mumford in his Technics and Civilization was his synthesis of concepts developed earlier by Patrick Geddes and others into a rounded historical picture of how our technology developed. Mumford's interpretation is valuable for its distinction between "three successive but overlapping and interpenetrating phases": the eotechnic phase, the paleotechnic phase, and the neotechnic phase.²

The keystone of this analysis is the continued growth of man's mastery over non-organic power sources to supplement his own man-power. Although Mumford was not the first writer in this field, his statement of these concepts provides a valuable appraisal of the key long-term technological trends --- reaching back before the time of Bacon and recognizing the steady development in 'technological progress'. A brief summary appears in order.

¹ Mumford, Lewis. Technics and Civilization. New York, Harcourt, Brace & Co., 1934. p 56-7.

² Ibid., p. 109.

The Eotechnic phase, or dawn age of modern technics, was based on a technology in which wood was the primary material and water power and wind power the primary sources of energy. In this phase of technological development the sources of mechanical power literally enriched the land instead of robbing it. The windmills and watermills were small and scattered: they ground the grain, pumped the water out of the lowlands and powered primitive industry. Lewis Mumford indicates that European economy was in the Eotechnic phase from the year 1000 AD to about 1750. It reached the British Isles at a later, but overlapping period; and only reached the Americas after 1700.

The Paleotechnic phase: "after 1750 industry passed into a new phase, with a different source of power, different materials, different social objectives".¹ The different source of power was coal, converted by the steam engine; -- that smoking, stream-polluting, noisy maker of cities. The different materials were chiefly iron and steel, from ore dug and smelted with the aid of coal and the steam engine. The different social objectives were those of a growing capitalism: workers received a new discipline of starvation, ignorance and fear.² A doctrine of progress was born:

Man, according to the philosophers and rationalists, was climbing steadily out of the mire of superstition, ignorance, savagery, into a world that was to become ever more polished, humane, and rational.³

¹ Ibid., p. 151.

² Ibid., p. 173.

³ Ibid., p. 182.

To which Lewis Mumford ironically added:

But German miners in the sixteenth century frequently worked in three shifts of only eight hours each (and) the facts of progress, when one surveyed the mines of the nineteenth century, were non-existent.¹

Nineteenth century miners worked on shifts from dawn to dark, or dark to dawn-- 12 hours or more in the pits each day.

The Neotechnic phase is 'a true mutation, adult of the eotechnic baby'. It was born in the nineteenth century with the development of gasoline and electric power, alloy metals and synthetic materials. The new power sources provided antidotes for the excesses of the paleotechnic phase, theoretically enabling the elimination of unhealthy factories and the planned decentralization of homes. With the neotechnic phase the potentialities of the industrial revolution reached a new high: the advantages of the eotechnic living conditions could be reintroduced and supplemented by a vastly greater non-organic power complex.²

Since Technics and Civilization appeared in 1934, a new phase has become painfully evident, a phase which overshadows all previous phases: the atomic age. It is interesting to note that the atomic age was foreseen in principle nearly fifty years ago by imaginative writers,

¹ Ibid, p. 183. ² National Resources Committee. Technological Trends and National Policy. Washington, D/C., U.S. Government Printing Office, 1937 . p. 249, gives a figure of 1,230,816,000 hp as the total for U.S.A. in 1935. This figures out at about 10 hp for every man,

and had already become a subject of intense debate in scientific circles by 1930:

Life in the future will be speeded up infinitely beyond the present. Sources of energy will be tapped and harnessed far outrivalling what we have today. There lies in full view before us a realm of discovery in physical science till now untrodden by mortals even in their dreams.....we now know that in atoms of matter there exists a store of energy incomparably more abundant and powerful than any other of which we have thus far obtained control. If once we can liberate this force, what machines we can build ! Steam and electricity will be an anachronism at which our children will laugh as we laugh at the hand loom and the spinning wheel. With a pound weight of this radioactive substance we will get as much energy as we now obtain from 150 tons of coal. Or another pound weight can be made to do the work of 150 tons of dynamite.....enough to blow a modern city into oblivion.¹

The atomic scientists now place the birth of the atomic age about the year 1900 with the discoveries of radioactive elements by Pierre and Madame Curie in Paris. Up till that time all chemistry had dealt with the electrons on the peripheries of the atoms. Now the nuclear structure of the atom itself has been attacked. The scientists dealing with nuclear physics rank the discovery and release of atomic energy above all but one prior discovery of mankind: the discovery of fire ! ²

This is the new atomic age, where the energy released

woman and child in the country. This is a deceptively low estimate. Mumford, Technics, op. cit., states in passing "the fact that the ordinary workman has the equivalent of 240 slaves to help him..." (p. 325) Non-power devices make the difference.

¹ Fosdick, Raymond. The Old Savage in the New Civilization (1930), quoted in Thornton, op. cit., p. 81.

² Lectures of Professor Woodward of M.I.T. physics department, December 1946.

by one bomb can demolish a medium size city or run all of its municipally owned facilities for more than a year.¹

But the atomic age is not the last phase in power development. Experimental work is continuing which will eventually result in the economic release of power from the sun's radiation and from cosmic rays.² We must look forward to a "cosmic age" which may come within our lifetime, bringing with it potentialities for literally unlimited power production.

Last week came startling news from the Academy of Sciences of Soviet Russia, suggesting the possibility that cosmic rays from interstellar space, which constantly bombard the earth from all directions, actually produce the disintegration of carbon, nitrogen, and oxygen atoms.....may mean that processes other than fission and synthesis may exist for disrupting the atomic nucleus of lighter and much more abundant elements.....If this is true, and the evidence so far appears intriguing, to say the least, a super-atomic age may be coming. As Dr. S. I. Vavilov, president of the Academy of Sciences of the U.S.S.R., stated, "The studies may mark the beginning of an altogether new chapter in the physics of the atomic nucleus".³

That American scientists are not slighting this possible development of the Russians is shown by the following:

WASHINGTON, Dec 14, 1946 (Special to the New York Times): Atom-smashing cosmic rays will be tracked this month in flying laboratories 40,000 feet above the Mojave Desert, the Navy Department said today....⁴

¹ Further discussed below, p. 123-124.

² Both sources of power are referred to in the New York Times editorial published 12 Sept. 1946 on "Prospects for Atomic Power".

³ New York Times feature column: Science in Review (Wm. L. Laurence), Sunday, 24 November 1946.

⁴ New York Times dispatch dated 14 Dec. 1946. The dispatch went on to state that three B-29s were assigned.

Another B-29 was assigned to M.I.T. last summer for similar studies. Theoretically at least, this latest development offers the prospect of absolutely unlimited non-organic power resources to mankind.

In summarizing this brief exposition of the growth of our technology through the eotechnic, paleotechnic, neotechnic stages, and the atomic age, it is worth mentioning that a number of people think the social changes which will inevitably result from the pre-atomic age factors alone, are too much for our civilization to absorb. These scientists and others want a "moratorium" on scientific development until the "cultural lag" has been significantly reduced.¹ In one particularly controversial book, Raymond Fosdick's The Old Savage in the New Civilization, fear was expressed that in science man had created a "Frankenstein monster that will slay its own maker".² Yet so long as individuals, corporations and countries continue to compete against each other, there can be no turning back the clock of science -- except by obliteration of our civilization through misuse of our new power. And a "moratorium" is

¹ Ogburn, Sociology, op. cit., p. 890. Ogburn makes further reference to an outstanding exponent of this view: Sir Josiah Stamp, The Science of Social Adjustment, London. The MacMillan Co., 1937.

² Quoted in Thornton, op. cit., p 81. Robert A. Millikan uses Fosdick's views to start off his own study of The Alleged Sins of Science, 1931. Millikan finds that science's only 'sin' is the inevitable accompanying "stupendous rate of change" that modern science and its application have forced on modern life. (Thornton, p. 90). Millikan defends science by stating we should not cross our bridges before we come to them -- forget about the "chimera" of atomic war !

therefore no solution.

(2) LONG TERM TRENDS IN PHYSICAL SCIENCES. Behind these long-term technological trends noted by Mumford and others may be found a steady development in the technics of scientific advancement, and in science itself. For city planners this improvement in technics is equal in importance with the development of physical inventions that now corrupt our city patterns through their elements of rapid change. Because some day city planning should itself be tied into the mainstream of technological and scientific progress !

Lewis Mumford, Thornton and others note about four significant long-term trends in the creation of the physical (and to a lesser extent, the biological) sciences. These are:

- (a) the emergence of the experimental method in science
- (b) the accumulation of a gigantic body of scientifically verified observations
- (c) the growing separation of applied science from 'pure' research
- (d) the development of huge research laboratories as opposed to individual inventors

(a) The experimental method as basis for technological progress began to emerge in the 17th Century:

This was a gigantic labor-saving device. It cut a short straight path through jungles of confused empiricism and laid down a rough corduroy road over swamps of superstitious and wishful thinking. ¹

¹ Mumford, Technics, op. cit., p. 133.

This experimental method rests fundamentally on a few simple principles:

First: the elimination of qualities, and the reduction of the complex to the simple by paying attention only to those aspects of events which could be weighed, measured, or counted, and to the particular kind of space-time sequence that could be controlled and repeated --, or, as in astronomy, whose repetition could be predicted. Second: concentration on the outer world, and the elimination or neutralization of the observer as respects the data with which he works. Third: isolation: limitation of the field; specialization of interest and subdivision of labor. In short, what the physical sciences call the world is not the total object of common human experience: it is just those aspects of this experience that lend themselves to accurate factual observation and to generalized statements....¹

The sciences built by use of this method are impersonal, non-organic, devoid of subjective and qualitative judgements. Conclusions reached can be verified at any time by doubters.

(b) The accumulation of scientific information tested by use of the experimental method has continued until today it constitutes a perfectly "staggering number of individual and minute observations and conclusions" which are accessible because of the remarkable simple system of written records and the use of a practically universal scientific language.²

(c) The growing separation of applied science from 'pure' research is perhaps the most important single trend in recent scientific advancement. Today, pure research is

¹ Mumford, Technics, op. cit., p. 46.

² Thornton, op. cit., p. 18 ff.

simply investigation to extend the boundaries of basic scientific knowledge. It is completely impersonal, utilizes scientific methods to the utmost, is unrelated to any specific applications, and is generally contributed to the fund of basic world-wide scientific knowledge. Results of pure research cannot be patented !

Applied science is also a research proposition but it is not directly aimed at developing any new scientific principles. Applied scientific research may be likened to scientific engineering or architecture; reaching into any and all fields of fundamental scientific knowledge and previous applications of that knowledge to find the elements of a new scientific synthesis -- a new invention.

Applied science is directed towards achieving a specific objective. The objective may be general. In some cases of industrial research the objective may be merely to find some commercial use of a by-product. But nevertheless an objective for the research exists and can be formulated and, if successful, patented ! Of course applied science sometimes contributes major advances to fundamental knowledge, but this is not the reason industry pays for the research.

Here is another example of the difficulty found in separating technological advance from political and social conditions. Pure research seldom makes money for its

sponsors. Applied research is usually undertaken ONLY if there is money in it for someone. Pure research is suitable for national and international support since it benefits all countries, since it is in fact an international undertaking of the human race (or was until atomic energy secrecy came along). Applied scientific research so far is NOT a subject for extensive national and international support.

This is extremely unfortunate for some aspects of our culture. City planning for example would benefit from applied scientific research into many of its problems, but there is at present no adequate expression of city planning in terms of money or potential profits. Perhaps some day political pressure will result in the expenditure of public funds, thereby providing incentive for this sort of research.¹

(d) The development of huge research laboratories has come as a direct result of the same forces which separated pure from applied science. The economics of specialization have led industrial corporations, institutions of education and governmental agencies to establish research laboratories.² The effects of this development will be discussed further below, page 36 in connection with the 'role of inventors'.

¹ See also the 'university' level, sections 4 and 7 below.

² National Resources Committee, Technological Trends, op. cit., p. 93 for examples of each.

Here we merely note that it is part of the long-term historical development of more and more efficient methods for creating scientific advances.

* * * * *

C. SHORT TERM TRENDS

(1) THE ROLE OF INVENTIONS. If long-term trends in technology radiate out to the frontiers of scientific progress, short-term trends of inventions form the paths that are followed.

Inventions have been called the 'stepping stones of technological development'. S. C. Gilfillan, in his work on the Sociology of Inventions adds to this idea:

What is called an invention is a perpetual accretion of little details, probably having neither beginning, completion, nor definable limits....It is an evolution, rather than a series of creations, and much resembles a biologic process.¹

Of course this change may not always be uniform in its rate. Just as there are mutations in biology, there are key inventions in technology which provide a sudden jump forward in achievement. An illustration of this evolutionary process of invention is afforded by the 'invention of the automobile', see accompanying illustration.

¹ Gilfillan, S.C., Sociology of Invention. Chicago. Follett Publishing Co., 1935. p. 275. From a brief summary of principles contained in the companion volume: The Sociology of Inventions.

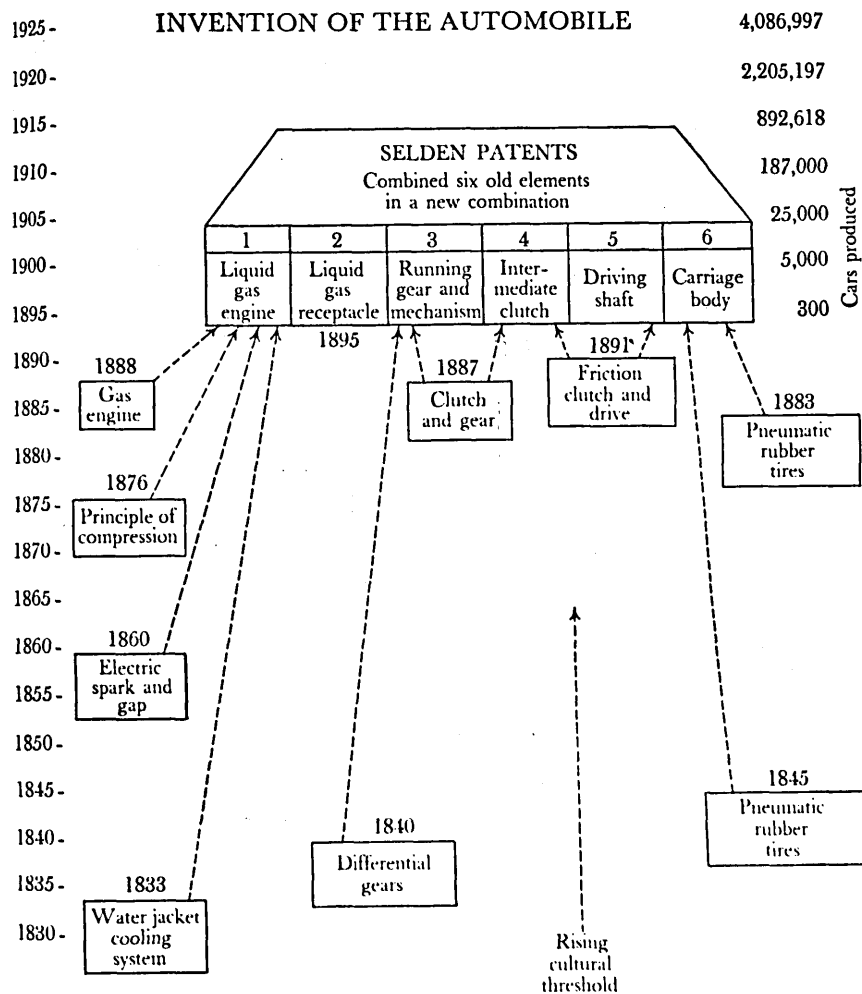


FIGURE 133. MECHANICAL INVENTION AS A COMBINATION OF KNOWN ELEMENTS

The automobile was made up of a few important existing inventions, as shown in the above chart. Thus the new grows out of the old. From F. STUART CHAPIN, CULTURAL CHANGE (New York: D. Appleton-Century Company, 1928), p. 336.

But so far as the social effects of inventions are concerned, there are two kinds of inventions: intensive and originative.

Originative inventions create industries; they include in their ranks the automobile, the telegraph, the radio, the manufacture of electrical goods in general. Originative inventions create employment at the same time as they create new types of goods.

Intensive inventions, as contrasted with originative, provide labor-saving devices, work displacers and capital savers. Intensive inventions improve methods of producing already known items. Of course some 'improvements' are so important that they revolutionize methods of making the item, cutting costs and expanding production. In such cases intensive inventions shade into originative, since more employment and more goods are created thereby.

A striking example of a purely intensive invention is the newly announced German invention, still held by the U.S. Army as a war secret: "a typewriter which takes dictation by itself",¹ thus presaging the end of stenography and typing.

Waldemar Kaempffert, Joseph A. Schumpeter and many others place great stress on the role of the originative

¹ New York Times: WASHINGTON (NANA) 21 Nov 1946: the release also states that a Dr. Vierling, an inventor of calculating machines, invented the typewriter. This creation may be valuable in its own right, or because of new scientific principles involved.

inventions. They form the elements of what Kaempffert calls the "boundless frontiers of science", a new frontier replacing the old frontiers of the "West" as a symbol of our technological opportunities.¹ Joseph A. Schumpeter calls the process "Creative Destruction", the essential fact about capitalism....."

In capitalist reality as distinguished from its textbook picture, it is the competition from the new commodity, the new technology, the new source of supply, the new type of organization (the largest-scale unit of control for instance) -- competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits and outputs of the existing firms but at their foundations and their very lives. This kind of competition is as much more effective than the other as a bombardment is in comparison with forcing a door, and so much more important that it becomes a matter of comparative indifference whether competition in the ordinary sense functions more or less promptly.....²

These originative, creative inventions which revolutionize industries are of paramount importance for our purposes as city planners. We should encourage new experimentation. Instead of piddling with minor street widenings and sewer extensions, occasional housing projects and playgrounds; instead of spending our time trying to remodel details of our obsolete present-day cities --- we city planners should have foresight enough to spend time and energy in so-called 'impractical ideas'. In the long run it will be new designs for living and new methods of achieving

¹ Kaempffert, Waldemar. Science Today and Tomorrow, New York, The Viking Press, 1945. p. 32ff.

² Schumpeter, Joseph A. Capitalism, Socialism, and Democracy, New York, Harper & Brothers, 1942. pp. 84-85.

those designs which will bring about the solutions we have been praying for !

S.C. Gilfillan points out a valuable corollary to this analysis of originaive versus intensive inventions -- the principle of functionally equivalent invention. This principle states that inventions are always paralleled by other, equivalent inventions that will achieve the same basic purpose of men, but founded on totally different methods. This concept is of vital importance in the prediction and general understanding of the process of invention, because if one invention fails to arrive and achieve the desired result, then some one or others of the various alternatives will replace it.¹ Thus we can be pretty sure that if private airplanes cannot be landed and launched from 100' x 100' fields through one method (brakes and catapults), then some other method of an entirely different sort will be developed; in this case it looks as if the helicopter will partially meet the requirement.

The concepts of originaive inventions and functionally equivalent inventions will be increasingly more important to city planners as the "technology of planning" is developed.

(2) THE ROLE OF INVENTORS. Inventions do not just happen. They are created. And the mechanisms by which

¹ Gilfillan, Social Effects of Inventions, op. cit., p. 137-148.

they are created are extremely important to those who want to make the most of future technological development.

We can distinguish two kinds of information regarding the creation of inventions: (a) concerning the concept of inventing, and (b) concerning the methods by which inventions are created.

(a) The concept of inventing as a process has become common in recent years. What appears to be one of the most advanced statements of it comes from P. Reh binder, a member of the Academy of Sciences in the Soviet Union, who:

does not consider the primary function of applied science is to solve the problems of industrial production, but to create new industries. The applied scientists should by research and imagination discover what can be done with the materials of nature and then indicate in which direction the creation of new industries and the improvement of old ones is possible. He believes the old conception of the industrial scientist as a consultant who will merely solve difficulties that arise during manufacture is false and uneconomic. The scientist will be the most economically valuable when he is leading the direction of economic development, for his power of discovering the possibility of new industries is vastly more valuable than his capacity for making trifling improvements.¹

This approach stresses the creative possibilities of originative inventions, more than any other aspect of inventing. However it should be remembered that there are many ranks of scientists and many kinds of science. Undoubtedly there should be some who specialize in the

¹ Crowther, J. G.. Soviet Science, New York, Dutton, 1936. p. 29.

creative possibilities of applied science. But there are plenty of scientists required elsewhere too, on more or less routine filling-up-the-gaps between larger inventions which create new industries. City planners should include in their profession some of both --- when the day comes for city planning as a real technology !

This approach is strikingly supported by the following observation by the dean of American scientific commentators, Waldemar Kaempffert:

Reflective students of economic and engineering history must be struck by the curious circumstance that revolutionary inventions are usually conceived not within but without an industry. The 'inside' inventor seems shackled by tradition; the 'outside' inventor cares nothing for precedent or for the established manufacturing procedure and boldly attacks a problem without concerning himself with vested interests. ¹

Here is another broad hint that the answers to our city planning problems may be found only by a truly free and imaginative approach to their solution !

(b) The methods by which inventions are created have undergone a radical change during the past generation. As was noted earlier, page 30, the days of that traditional source of invention, the private inventor, are ending. The 'heroic' inventors of the Howe, Fulton, Watt, Goodyear, Morse and Edison tradition belong chiefly to history.

¹ Kaempffert, op. cit., p. 238.

So long as the relatively easy and simple things remained undone, the inventor was the dominant figure. He still retains his place in the adaptation of established principles to new combinations of circumstances. But.....Commercial enterprise finds itself confronted with problems which are beyond the powers of the inventor of an earlier generation and which can be solved only by trained scientists.....¹

Instead of individual inventors, and with the rise of scientific invention based upon research organizations, group inventions have become important:

Group inventors are well paid; they eat three meals a day; they go about their work of creating new mechanisms as methodically as if they were clerks; they belong to a professional class.....In these laboratories of industry every phase of a subject is considered. Thus we find Bell Telephone laboratories study acoustics and the relation of ear to sound.....relations are established with foreign companies.....the world is thus enmeshed.²

There is a second angle to this elimination of inventors. The usual "poverty-stricken private inventors lack the resources for modern scientific research and for marketing their products".³ This fact has two interesting connotations for city planners -- our patent system may actually be stifling rather than promoting research development, since large corporations use the patent privileges to corner their markets and to slow up developments in technology

¹ Thornton; op. cit., p 47-48.

² Kaempffert; op. cit., p. 243-244.

³ Burns, Arthur Robert. The Decline of Competition - A Study of the Evolution of American Industry. New York, McGraw-Hill Book Co., 1936. p. 420.

which might reduce the value of their holdings.¹ Secondly, if the development of large scale industrial research agencies means anything, it indicates the advisability of creating large scale research agencies for planning.²

Both of these factors will undoubtedly have an effect on the use of technology for future city planning. Some day the research problems of city development will be handled by research departments cooperating with, and combining the research activities of, other such departments all over the world -- and applying the results to their particular localities. There will be city planning research specialists and city planning engineers: the former being specialists in research, the latter being specialists in carrying out details of plans. But for the present, the days of the individual city planning 'inventors', of Ebenezer Howard, F.J. Osborn, Le Corbusier, Frank Lloyd Wright; these people still have a role to play in the city planning movement.

When we can demonstrate huge savings of all kinds for new, planned cities --- then and only then will new cities be built and old cities be rebuilt. A proper understanding of how inventions are created will help bring this final solution of our city problems into being.

¹ Thornton; op. cit.; Part II. Especially pp. 142 thru 163.

² National Resources Committee, Technological Trends; op. cit.; summary of conclusions, p. vii, et seq. supports this idea in detail.

* * * * *

(3) COMPLEX NATURE OF A MAJOR ORIGINATIVE INVENTION.

The multiple effects of a single originative invention on city planning may serve to indicate the complexity of unguided technological possibilities. Because of its current interest to planners, the automobile has been chosen. Works cited in the bibliography, particularly the National Resources Committee symposium: Technological Trends and National Policy, provide many other examples.

The first successful automobile was a steam driven, three wheel affair which bounced down the muddy ruts of France in 1769, almost 200 years ago.¹ Later models followed. However because of bitter opposition by landowners, stagecoach proprietors, breeders and users of horses; combined with opposition of railroad operators in the 19th Century; the more and more serious attempts to produce automobiles in quantity were met by more and more stringent regulations. Automobiles were effectively ruled off the roads in England until 1885 when the last major restrictive law was repealed.²

By 1895 a complex of inventions, illustrated by the chart shown following page 31, had insured that a really practical automobile could be produced in quantity. Techniques of mass production already utilized in other fields of

¹ National Resources Committee. Technological Trends; op. cit., p. 43.

² Ibid, p. 43.

manufacture were available and Henry Ford soon pioneered in producing low cost mass automobile transportation.

Then came the second wave of repercussions. The nightmares of those who opposed the new invention 100 years ago have been matched by reality. By 1924 the New York Regional Plan Association was able to estimate that traffic congestion in downtown Manhattan had increased to where accountable losses were measured in terms of a half million dollars a day,¹ with automobile traffic accounting for most of the waste. This effect, so well known to planners everywhere in America, is only one of the literally innumerable effects of the automobile on our society. The illustration (next page) indicates only some of the more important repercussions.

Furthermore, the effects of the automobile as a single invention were multiplied by the fact that it developed only as one of a whole complex of complementary inventions. The automobile could scarcely exist, it could certainly not become popular, until it was aided by corollary inventions of hard-surfaced roads, networks of filling stations and garages, and a machine tool industry capable of turning out thousands of parts by mass production methods.

1

Lewis, Harold M., and Goodrich, Ernest P.. Highway Traffic, Regional Survey Volume No. III; New York, New York. Regional Plan of New York and Environs, 1927. p. 61.

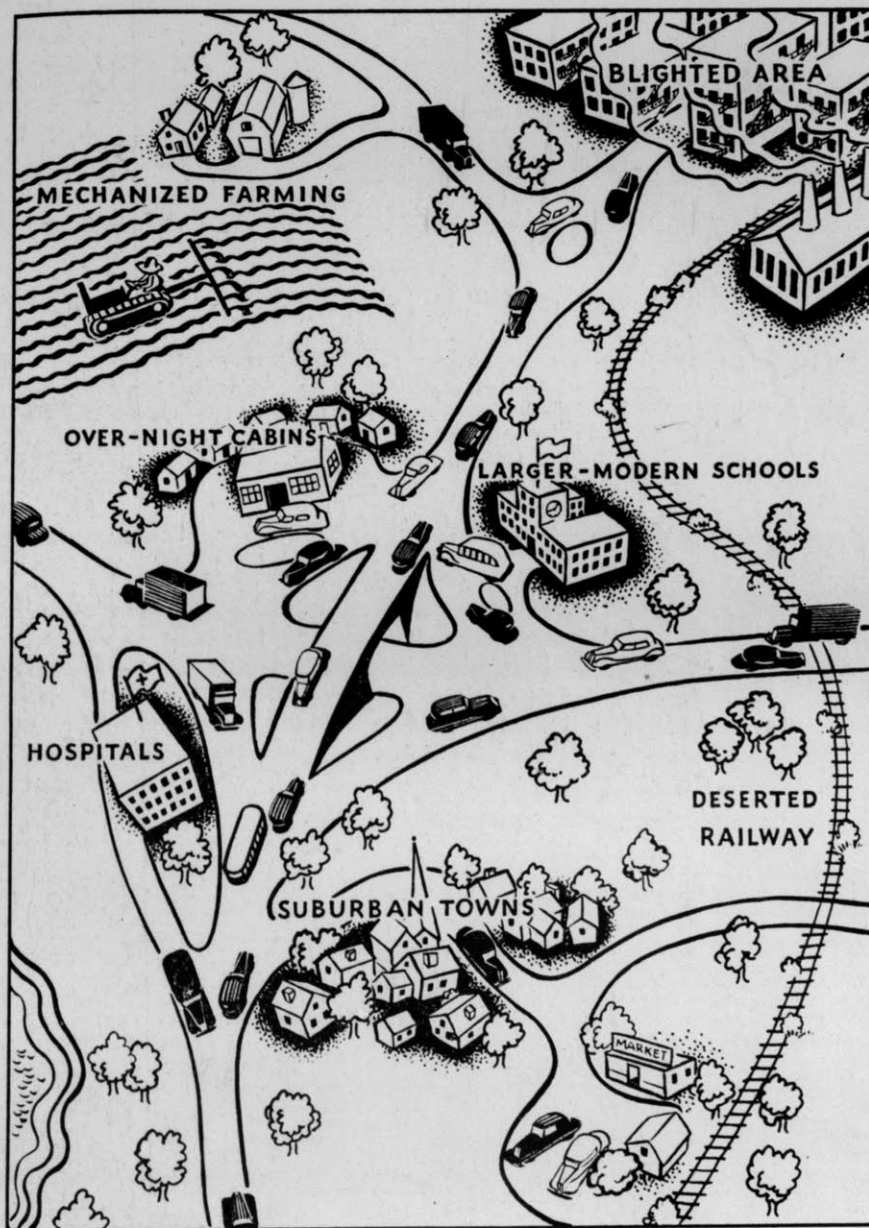


FIGURE 143. THE SOCIAL EFFECTS OF THE AUTOMOBILE

The influences of the automobile on society are so numerous that they are incalculable, but the above sketch shows a few of the important ones. From WILLIAM F. OGBURN, MACHINES AND TOMORROW'S WORLD, published by the Public Affairs Committee of New York City.

And finally, the automobile and its own complex of inventions, have had indirect results on our society. Professors Ogburn and Nimkoff in their textbook Sociology point out the following obvious example:

This combining of influences (the effects of a number of inventions) is a very common phenomenon. The growth of suburbs (*italics mine*) is the result, not of the automobile alone, though it is a significant influence, but also of the electric railway, the steam railroad, the telephone, the radio, the moving picture theatre, and the chainstore. These are all very different material objects and have different uses, yet all are centered on one result, namely, the creation of suburbs, whatever may be the other purposes they serve. It is as though the influence of a variety of inventions were poured into one groove.¹

Thus the combining of influences from a number of inventions form a super-cluster which, taken as a whole, has effects that would be impossible to achieve otherwise. And real prediction of those effects becomes unbelievably difficult. There are too many complications.

When we turn to other major inventions we find the same pattern of direct and indirect effects. A statistical attempt was once made to enumerate the important social effects of the radio telephone, telegraph and radio broadcasting inventions: 150 different effects in 11 major categories were noted.²

The authoritative study, Technological Trends and National Policy, furthermore concludes that almost all major

¹ Ogburn, op. cit., p. 858.

² President's Research Committee, Recent Social Trends. New York, McGraw-Hill Book Co., 1933. p. 153 ff. Categories included recreation, transportation, education, industry, business, government, and politics; and reciprocal effects on OTHER inventions !

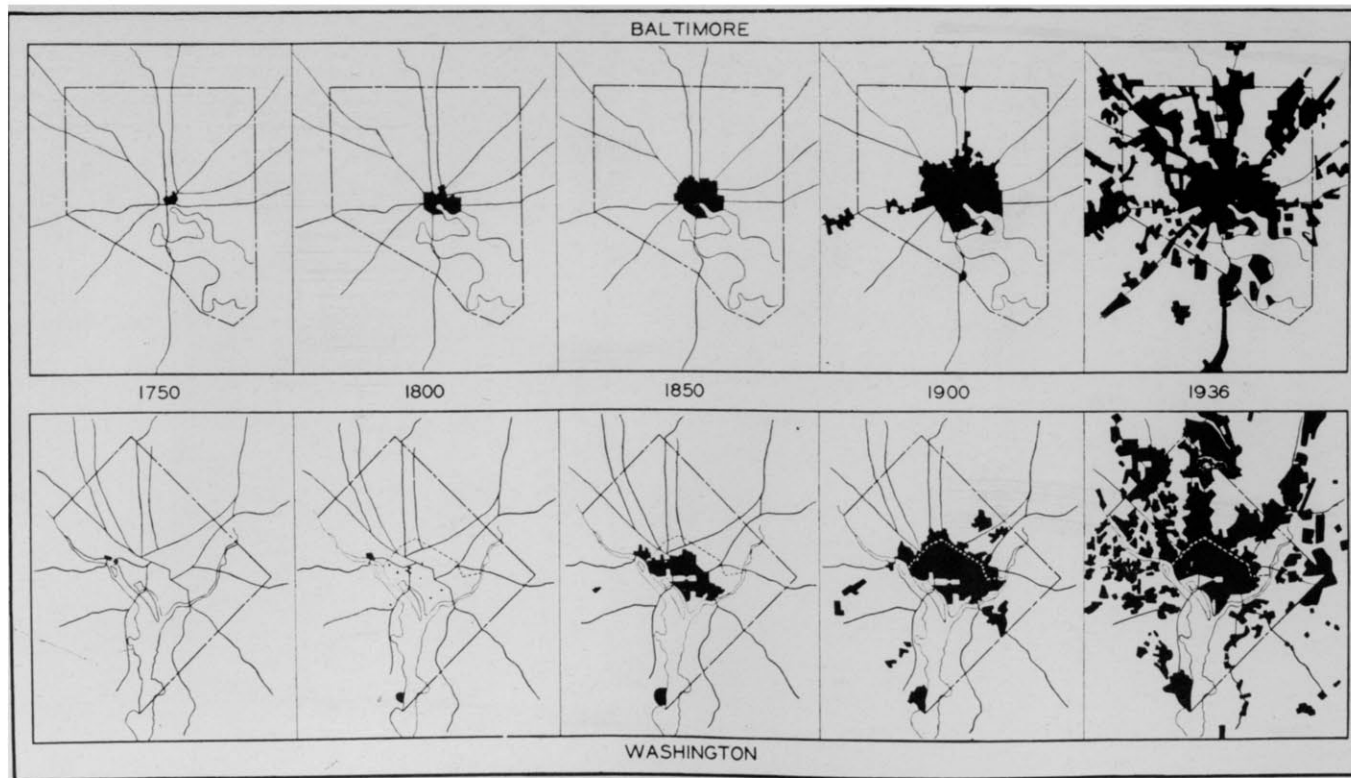


FIGURE 22. Urban explosion: Time exposure, 186 years. Black means built-on land.

inventions had these elements in common¹: (a) their prototype forms were in existence literally generations before they won general acceptance, (b) they faced bitter opposition from existing vested interests in competing lines of economic activity, (c) they were exploited finally by individuals and economic groups in the interests of making the maximum return on the minimum investment --- regardless of the resultant social effects, (d) their direct and indirect effects as part of a complex of related inventions are literally impossible to foresee and predict in their entirety, because of their world-wide ramifications.

These characteristics of a major originative invention are considered relatively obvious at least to students of the field. Further examples may be found in such studies as Technological Trends and National Policy, Social Effects of Aviation, and Invention of the Ship, etc., listed in the bibliography.

City planners may draw two general observations from this illustration of effects flowing from a major invention. First, the prediction of inventions under an unplanned society is too difficult to be of much value. That is, the entire complicated pattern of effects cannot be foreseen.

¹ National Resources Committee; Technological Trends, op. cit., pp 39-66 especially.

Second, new inventions (and this includes new ideas and concepts) will be naturally opposed by all sorts of vested interests. The idea of a new city form will be particularly upsetting to some people. Both of these observations will be developed more fully later on.

* * * * *

D. A FRAME OF REFERENCE

Keeping the role of short and long term technological developments in mind, one additional aspect of the "grammar-school" level of understanding must now be developed. This is the establishment of a frame of reference, a conceptual outline of the physical elements involved in shaping the human environment. The author found it indispensable as a tool of analysis and clear thinking regarding potentialities of technology.

However ~~this~~ frame of reference must be established in relation to the objectives for which it is created --- the proper satisfaction of human needs. So what follows is in part borrowing on the second, or 'high-school' level of studying human needs to see "whither should science be directed" !

A further and much more detailed study of four "trends" of exceptional importance to city planners will be discussed later (section 5). These four trends will

be foreshadowed in the frame of reference which follows.

Finally, a great many books have been written about the whole sweep of this outline, and many more have been written on each of its sub-sections. The bibliography at the end of this study lists eight or ten general works.

(a) Power Sources

Eotechnic ones included wind and water power.
Paleotechnic ones included coal, used in steam engine.
Neotechnic ones include electricity, gasoline, Diesel, and rocket fuels used in electric motors, gasoline and Diesel engines, turbines and jets; and rocket engines.
Atomic fuels, including cosmic ray potentialities.
Sun-energy power.

The potentialities of these listed power sources and possible power sources are sufficient for any known human purposes. We can create more prime mover power at will. However the cost of creating power is not yet negligible.

Further aspects of power development are considered below in Section 5.

(b) Production and Distribution of Goods

(1) Extractive industries, both organic and inorganic.

Eotechnic ones included agriculture, a few common metals including iron; but characterized by use of wood and glass as materials.

Paleotechnic ones included iron as predominant material, steel, and a more complete array of other metals.

Neotechnic ones include the 'new alloys, the rare earths, and the lighter metals; the synthetics; --including the plastics. A return to agriculture for raw materials is evident, as well as exploitation of the whole range of non-organic materials.

Atomic possibilities appear to be a new level of incredibly strong, light and durable alloys necessitated by production and use of fissionable materials.

Potentialities of modern basic extractive materials may be briefly illustrated by the following example of versatility: the eotechnic material, glass, can now be made out of combinations of 80 out of the 92 'natural' elements. Among its uses: "Glass so hard it will stop a fifty-caliber bullet; glass that can be sawed, drilled, and worked with carpenter's tools; glass so light that it floats on water; glass wool so fine that a marble-sized ball of glass will spin 20 miles of thread; explosion-proof glass globes for use in war plants; glass that can be heated red-hot and plunged into cold water without damage; glass tubing that replaces copper, lead, and steel in plumbing; glass that can be bent and tempered to almost any shape; glass springs that don't get 'tired' and are equal to steel ones; glass automobile batteries"¹.

Nazi Germany used the other main eotechnic material, wood, for almost every chemical process in the book. This was a consciously developed technique, to overcome the shortages of raw materials in Germany. Wood was plentiful. Other raw materials were not. So modern technology was called upon to turn wood to an infinite variety of chemical purposes.²

(2) Fabricative Industries, (turning raw materials including chemical compounds into finished products.)

Here again, supply seems completely conditioned by demand. During the war labor-saving devices and special machinery were built at rates which would, if continued, approach elimination of all mechanical human labor in 20 years. One instance: "The science of electronics has been advanced to a point where its value is now comparable to the acquisition of one hundred million new skilled workmen."³

(3) Distributive Industries, (warehousing, retail and service.)

All economists agree that these functions are purely a creature of the situation, of the demand for their services. Judging on any basis of what

¹ Carlisle, Norman V., and Frank B. Latham: Miracles Ahead New York, MacMillan Co., 1944. p. 197.

² Glesinger, Egon. Nazism in the Woodpile, Indianapolis, Bobbs-Merill Co., 1942.

³ Carlisle, op. cit., p. 5.

constitutes an efficient unit of business operation, the number of firms is greatly in excess of needs.¹ Furthermore the trend seems to be towards efficient units of larger and larger sizes.²

(c) Circulatory Activities

(1) Transportation of goods and people.

Eotechnic methods included foot, horse and wagon, sail boat, canal and row-~~ba~~rges.

Paleotechnic ones included railroad, steam boat, street car.

Neotechnic ones include automobile, truck, bus, subway and elevated, airplane, rocket, escalator, elevator and conveyor-belt.

Atomic ones propose interspatial travel.³

Revolutionary modes of travel have been crowding each other for acceptance, due to wartime and military inventions. There is no known factor to prevent continuation of improvement in accordance with curves indicated by Hornell Hart (see below, p. 56), and section 5 discusses some of the implications.

(2) Communication.

Eotechnic methods included voice, drums and bells, visual signals, and letters.

Paleotechnic ones included telegraph, telephone, sonic devices.

Neotechnic ones include wireless, radio, television, radar, infra-red; and combinations such as teleran (television plus radar), radar-scope.

Here too, revolutionary modes of communication have begun crowding one on another to the point where time and space have been eliminated as barriers. It is already technically possible to simultaneously

¹ Burns, Decline of Competition, op. cit., passim; pp 8,9,25, etc. Also Beede & Means, The Corporation and Private Property, New York, 1932.

² See further discussion, p. 98-99.

³ New York Times. A.P.L. Dispatch, August 27, 1946, gives estimate that first earth-to-moon rocket will be launched within 18 months !

show moving pictures in a hundred cities of an event taking place thousands of miles away. Here too, the only possible generalizations are that: (a) future development will unquestionably bring costs down, and (b) any known requirement can be satisfied in one way or another -- unless we seek in the biologic field of "mental telephathy"! See section 5.

(3) Transmission of Power (origin to place of use)

Eotechnic methods permitted a maximum of $\frac{1}{4}$ mile by mechanical means, slightly further with water-works canals.

Paleotechnic methods included transportable fuel (coal), but usually steam plants used so much coal that they had to be located near coal mines.

Neotechnic methods show a trend towards disassociation of power production from power use. 'Fuel' transmission by power transmission lines and pipelines.

Atomic potentialities indicate a trend towards elimination of power transmission as a 'problem'. Possibility of transmitting power through the air, and actuality of transmitting uranium via air.

See section 5 for further discussion.

(d) Direction and Coordination

(1) Organization

The science of organization has not been given the thought it deserves. Generally speaking, scientific developments including such skills as business machines and rapid communication have created what must be considered the basis for a new technology: the organization of men to get the maximum amount of use out of their services; reducing to mechanical devices all functions not requiring human intelligence in the selection of alternatives.

As a generalization it appears that this new science is moving in a trend towards 'the larger an organization, the more efficient'. Economies of mass-production in organization only begin to pay for mechanical handling methods when huge size is attained.

(2) Social and Political

Technology has not neglected entirely the direction

of social and political activities. In addition to the effects of communication and transportation aids, and in addition to technical inventions to help human organization, techniques are being developed which improve man's ability to judge human desires and to reach group decisions. Ranging from Gallup Polls and individual 'audience-reactors' (electrical devices actuated by the listeners to indicate approval or disapproval of statements made --- the total result being recorded on a screen or dial), to loud-speakers and to improved social research techniques; here is a scarcely-touched field for the technological explorer.!

* * * * *

Now regarding the elements of this 'conceptual framework', one important observation should be kept in mind.

Inventions persist: in the modern world they rarely pass totally outofuse, still less outof memory. But inventions are rarely rejuvenated. Once the progress of one has ceased it is rarely resumed in like nature..¹

Inventions persist. This is a key to understanding how this 'framework' is modified as time goes by. The old inventions remain, but man's basic purposes are in some respects served by newer and more efficient methods. An invention such as the wagon for transportation purposes persists in use. It still serves a useful function in half the lands of the world. But it is being relegated to a position of lesser importance by the introduction of newer methods of transport. As the use of all kinds of transportation becomes widespread over the globe, relationships between the various kinds will have to be adjusted; but complete elimination of any one

¹ Gilfillan, Invention of the Ship, op. cit., p. 276.

is unlikely. Railroads are not going to disappear. Neither are canals or mules. But they will be displaced in some areas where other methods of transportation are more efficient, and a 'new equilibrium' will be achieved between the various kinds of transport in each area.

In this way new inventions expand the flexibility of existing technological tools for serving man's basic needs. This 'conceptual framework' is continually growing.

* * * * *

E. PREDICTION

The understanding of past and present technological trends is not complete without knowledge of how to predict future trends. The problem is twofold: Can we predict inventions and their impact on city planning? And if so, how far in advance.

This query can be answered if we break it down into its major components and consider each separately.

To begin with, prediction must be considered on two fundamentally different levels. First, prediction with the professions of city, regional and national planning as they are today. Secondly, prediction with fully operating central research organizations as outlined in the following sections. At this time only prediction under present conditions will be considered.

And secondly, a basic distinction must be made between prediction of ~~long-term~~ (historical) trends, and prediction of short term trends of invention.

(1) SHORT TERM PREDICTION. It is safe to say that inventions affecting the future of city planning are no more difficult to predict than any other inventions. Therefore the conclusions of Technological Trends and National Policy regarding the prediction of invention in general are pertinent. S.C. Gilfillan came to the following conclusions in his carefully documented article on the Prediction of Invention.¹

(a) Prediction based on extension of trends within technology is practically certain of success:

When we see patents piled ever ~~thicker~~ upon food syntheses, or see aircraft capable of landing in less and less space, or television screens growing larger and finer, we readily, confidently, and justifiably project these trends forward a short way into the future.¹

(b) Prediction of specific inventions is likely to succeed if we do not forget the principle of the functionally equivalent invention (see above, page 34), and if we remember that today no invention is born overnight. Gilfillan's studies indicate that several scientists were able to predict specific inventions with an accuracy exceeding 70%. The general conclusion he reached is:

¹ National Resources Committee, Technological Trends, op. cit., p.18.

Though the influence of invention may be so great as to be immeasurable, as in the case of gunpowder or the printing press, there is usually opportunity to anticipate its impact upon society since it never comes instantaneously without signals. For invention is a process and there are faint beginnings, development, diffusion; and social influences, occurring in sequence, all of which require time. From the early origins of an invention to its social effects the time intervals average about 30 years.¹

Gilfillan develops this idea of the 30 year lag a bit further:

Searching for exceptions, it is hardly possible to find an invention which became important in less than 10 years from the time it or some fully equivalent substitute was worked on, and few did so in less than 20. Here is then, an excellent rule of predictions for the present study -- to predict only inventions already born whose physical possibilities have therefore been demonstrated, but which are not yet practical, and whose future significance is not commonly appreciated.² (*italics mine*)

(c) Prediction is made easier because all inventions have causes. Where needs which have a monetary value exist, research organizations and inventors are at work. Books are published listing needed inventions.³ The U.S. Patent Office reports half the applications they receive are dropped, mainly because of prior inventions; surely convincing proof of duplicate inventions springing from common need.⁴ Inventions are created where need exists.

(d) Finally, prediction becomes more sure when it is

¹ Ibid., p. vii (Findings). ² Ibid., p. 19.

³ Yates, Raymond. 2,100 Needed Inventions, New York, Winfred Funk, 1942. Also Furnas, Unfinished Business of Science, --The Next Hundred Years, N.Y., Renal and Hitchcock, 1936.

⁴ Technological Trends op. cit., p. 19.

authoritative: "Distinguished technical and scientific men, who choose to predict in their own general field, made the best seers of all";

There seems to be a clear case for a committee of technical men uniting their labors, together with those of social scientists and students of Prediction. This has been the basic assumption underlying the arrangement of this present volume.¹

* * * * *

These conclusions of S.C. Gilfillan provide an explanation of the method and potential/accuracy of "scientific prediction" under present conditions. Prediction IS possible by properly informed technicians for perhaps a generation into the future. As will be shown in the next section, this should be enough for city planning.

However there are many pitfalls in prediction. The potentialities of radio broadcasting were not seen by most people who should have known better until after the first commercial broadcasting station, KDKA, hit the air in 1920. ² Radar was predicted only indirectly, as a functionally equivalent invention.

The most common pitfalls in prediction of invention appear to be: (a) sheer optimism, (b) inability to foresee changing tastes, customs and laws, (c) failure to estimate true costs, (d) ignorance regarding basic technological possibilities.

¹ Ibid., p. 18.

² Ibid., p. 17.

(a) Optimism is practically another method of invention these days, for in our advancing technology the wish may be the father of the act ! But "scientific fiction" is full of weird predictions such as space ships capable of travelling at square the speed of light, and mass telepathy, which may be considered unlikely. And optimism is frequently carried too far as regards timing of practical applications of inventions.

(b) Inability to foresee changing demands; tastes, customs and laws also leads to inaccurate predictions. Ebenezer Howard's adaptation of the crystal palace idea as a part of his great social invention of the 'garden city', and many wainstorms of Edward Bellamy's Looking Backward exhibit qualities of possible but not probable developments. Likewise the telharmonium, pneumatic tubes for delivering food from central kitchens to private homes, and the standard use of lie detectors in criminal investigations were all predicted long ago and were all actually created long ago. But they have not won popular acceptance because they require changing existing tastes, customs, or laws.

(c) Failure to estimate costs has led to errors in prediction. Home color sound films, to be rented from film libraries as you now borrow a book, are completely practical and desirable today, but the projectors and film still cost too much to compete with books and moving picture theatres.

(d) Ignorance regarding basic technological

possibilities is perhaps the commonest source of error of them all. A leading example of it among city planners is that exhibited by Hilberseimer. He designed his 'new city' around a scheme of reorienting cities according to prevailing wind, to minimize the smoke problem. He never tumbled to the fact that if we can find how to rebuild our cities we will undoubtedly also solve the problem of industrial smoke. (See section 6-B below for further discussion).

* * * * *

Thus according to Gilfillan, we may conclude that even under present conditions we can estimate the pattern of inventions for the next generation. We only need to keep a careful check on presently known inventions and ~~their~~ potentialities, and systematically screen these potent possibilities against what we know to be important (in terms of money or political vote-getting) human needs. For city planners this means that full use of present knowledge of technological powers plus some common sense should be sufficient for sound creation of cities for the future.

(2) LONG TERM PREDICTION presents an entirely different situation. Here we are dealing not with technological details, but with the whole sweep of technological and scientific advance. If we can grasp the whole pattern of technological progress, then the details of

individual inventions are thrown into much better focus. We can then relate such achievements as rocket planes, atomic power and dial telephones, and we can base predictions as to the general trend of technology on an appropriate level of understanding.

Study of current works indicates that we can distinguish one major and two corollary long-term trends. The major trend is towards "technological acceleration". The corollary trends are towards a 'surplus technology', and towards a 'unified field of scientific knowledge'.

And furthermore, by considering these three trends together, we can foresee the outlines of an entirely new concept of "technological prediction".

(a) Technological acceleration is forcefully demonstrated as the key long-term trend in a recent article by Hornell Hart. In Technological Acceleration and the Atomic Bomb, Hart presents his thesis that

Throughout the entire sweep of history and prehistory the power of human beings to achieve their basic purposes has been increasing at accelerating speed, with local and temporary stagnations and setbacks. This long-run acceleration has taken place through series of logistic and Gompertz surges, having higher and higher rates of increase.¹

¹ Hart, Hornell. Technological Acceleration and the Atomic Bomb. Published in American Sociological Review, June 1946, Volume II, No. 3. p. 277 ff. Quote is from page 281.

N.B. that "local and temporary stagnations..." are interpreted to mean such 'details' as "cultural stagnations of India and China lasting hundreds of years". This is a really broad generalization !

Briefly, Hart's analysis can be illustrated as follows. One of man's 'basic purposes' is to travel more rapidly. To achieve this basic objective, man has developed faster and faster methods of transport: on horseback, on railroads, in automobiles, in airplanes. Now if we draw a curve connecting the various speed records as years go by, we find that man is developing ways to travel faster at an accelerating rate. Man took literally millions of years to invent ways of travelling over 40 miles per hour. Now he can travel many hundreds of miles per hour, and we can foresee speeds over a thousand miles per hour in the near future. This curve is reproduced from Hart's article on the next page.

An interesting fact emerges regarding the individual speed records which make up the key points on this curve. Each speed record represents the effective peak of efficiency by one 'mode of travel'. As a new method of travel, say the railroad, is introduced, it is developed rapidly at first. Then the process of its improvement gradually slackens off to a plateau of efficiency as insuperable obstacles arise to prevent further development. Thus the speed of railroads and automobiles and reciprocal engine aircraft and even jet aircraft has gradually found an upper limit. These cycles of improvement for any given 'mode' of travel, or for any origina^tive idea or invention for that matter, were 'discovered' by Gompertz. Hence the

TABLE 2. WORLD SPEED RECORDS, IN MILES PER HOUR

Year	Race horse	Locomotive	Automobile	Year	Race horse	Locomotive	Automobile	Airplane	Year	Race horse	Automobile	Airplane	Jet plane
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1800?	34.8?	...	...	1901	...	120	54	...	1923	...	...	267	...
1813	...	5	...	1902	...	...	...	23	1924	...	...	278	...
1825	...	15	...	1903	...	130†	90	...	1925	36.7	...	...	...
1829	...	44	...	1904	...	...	...	40	1927	...	204	290	...
1848	...	68	...	1905	35.7	127†	110	...	1928	...	207	319	...
1875	33.7	...	...	1906	...	...	128	...	1929	...	231	358	...
1880	34.0	...	...	1908	...	...	...	48	1930	36.8	...	...	...
1885	34.2	...	...	1909	...	...	...	50	1931	...	246	415	...
1890	34.7	...	...	1910	36.1	...	141	68	1932	...	254	...	...
1893	...	112	...	1911	...	...	142	83	1933	...	272	424	...
1894	...	...	13	1912	...	...	...	107	1934	...	...	441	...
1895	35.0	...	15	1913	...	...	...	127	1935	36.9	277	...	...
1896	...	...	16	1915	36.5	...	...	...	1937	...	311	...	...
1897	...	...	25	1919	...	...	156	...	1938	...	357	...	...
1898	...	...	27	1920	36.6	...	...	194	1939	...	369	469	...
1899	...	...	42	1921	...	...	...	205	1940	36.9	...	...	...
1900	35.4	...	...	1922	...	...	...	248	1945	37.0	...	...	640

† The record of 130 m.p.h. in 1903 was made by an electric locomotive; the record of 127 m.p.h. in 1905 was made by a steam locomotive, as were all the other records in columns (3) and (7).

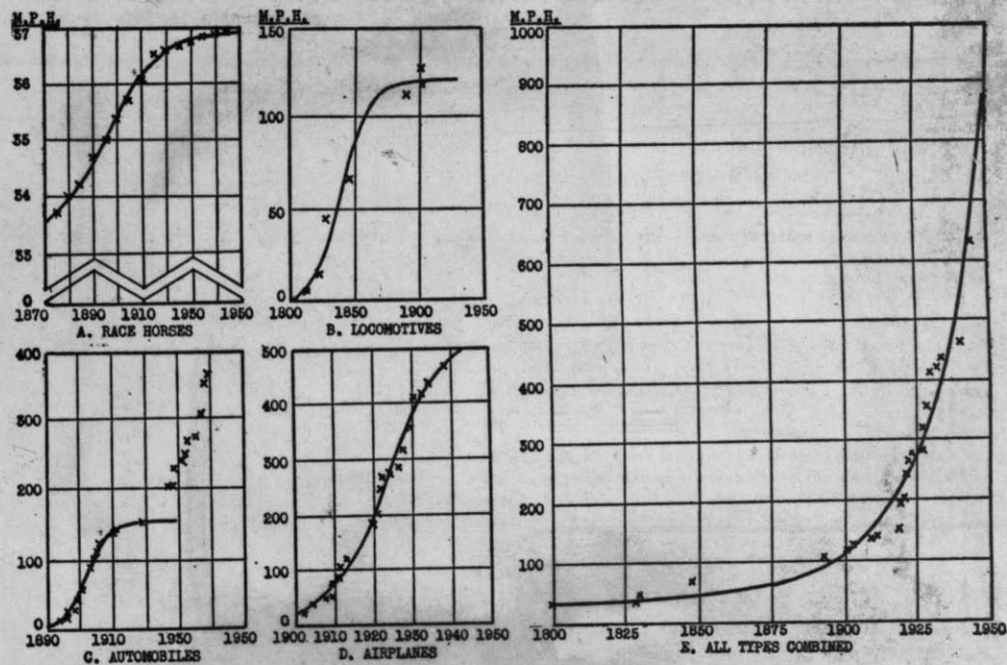


FIGURE 2.

World speed records, with logistic trends fitted to four separate types, and loglog trend fitted to combined records

TECHNOLOGICAL ACCELERATION

From Hart, Hornell, Technological Acceleration and the Atomic Bomb, American Sociological Review, June 1946, p.284-285.
(see over for part of explanation for these curves).

But suppose that it be admitted that the four logistic trends of Figure 2 are not mere chance fluctuations, and are not due to biased selection. A further objection is then raised to accepting the general accelerating curve (Figure 2E) on the ground that "it merely summarizes a trend which appears when diverse population elements are thrown together." To make the objection clearer, let us suppose that one were to select horse

speed records for the years 1900 to 1915, were then to select automobile speed records from 1919 to 1938, and finally to select airplane and jet plane records for 1939 and 1945. Such selections would produce an even steeper acceleration than that actually shown in Figure 2E. One can, of course, prove almost anything by arbitrary selection

of data. But no such arbitrary selection has entered into this study. Our hypothesis suggests that the persistent pressure of the human desire to travel more rapidly has kept mankind experimenting with various combinations of previous inventions, and has led to cultural selection of those, from among the potential and actual inventions, which best satisfied basic desires. The hypothesis thus *calls for* frequent shifts in the means used to accomplish the persistent purpose. The apparently heterogeneous devices employed are selected for inclusion in the series on the wholly objective basis of which de-

vice achieved the fastest official speed record.

The speed data do thus conform to, and to that extent do confirm, the hypothesis of cultural acceleration, both as to the general trend and as to the component logistic surges. It would of course be appropriate, for any critic who can do so, to point out any evidence that seems to him to indicate that the

author may have selected data arbitrarily to conform to his hypothesis. The author believes that he has successfully guarded against this source of error. Any critic who believes that he can suggest any alternative trend curves which might fit the data more closely is invited to do so. The author has not been able to find any such superior fit. Until alternative hypotheses of these or other kinds are supported by adequate proofs, the author believes that the foregoing analysis of speed records constitutes (in that area of technological change) a *prima facie* confirmation of the hypothesis.

TECHNOLOGICAL ACCELERATION

From HART, HENRI, *Technological Acceleration and the Atomic Bomb*, American Sociological Review, June 1946, p. 381-385. (see over for part of explanation for these curves).

name, "Gomertz surge".

The concept of "series of logistic and Gompertz surges" means simply that as one 'mode' of travel reaches a plateau of efficiency, then efforts of man to travel faster are diverted to improve entirely new technological means of achieving the same basic purpose. These new means are then used to break through the previous maximum efforts, just as the airplane surpassed the railroad and the automobile as methods of rapid travel. This concept is akin to the idea of functionally equivalent inventions, but it proceeds to a higher level of accomplishment rather than just reaching the desired immediate goal.

* * * * *

The interesting thing about this analysis is that similar accelerating curves can be found in man's record of achievement towards many of his "basic purposes". It matters little whether we study world speed records, records for destructive power of explosives, records for non-organic power production, records for strength of materials; records for better communication, more sensitive instruments, cheaper mass production, cheaper mass destruction. Wherever we can obtain data to construct a curve of man's successive efforts to reach a "basic purpose" through technological means, we find that the resulting curve of ~~of~~ maximum efforts by different 'modes' of accomplishment show the same constantly accelerating rate of increase.

Hart goes on to show the incredible statistical fact that some of these curves can be fitted with regular loglog curves (constantly accelerating rates of increase) within a statistical probability rating of one chance in a million !

Furthermore, evidence is introduced to show that predictions based on such curves as these are closer to reality than predictions based on the non-statistical estimates of generations of scientists. For example, the tremendous upsurge of power potentialities for mankind exemplified by the atomic age, of the order of 1,000,000 times as much energy per pound of active material as any previous form of energy release, is accounted for easily and accurately by a log-log curve of increasing rate of acceleration in modes of power production, or a curve of explosive destruction. Rapid future development of cosmic and solar power sources would also be in conformity with Hart's hypothesis.

And finally, these statistical studies are supported by the qualitative analysis of other authors. In fact Hart summarizes the views of twenty or more prominent authors as a beginning for his article. One of them, Professor Ogburn of Chicago, suggests a simple explanation for Hart's hypothesis:

The cave man was an infrequent inventor, at least one reason for this was that he had so little knowledge and there were so few cultural elements out of which to make an invention. Modern man is a

frequent inventor because he has so much knowledge, especially in such fields as mathematics, physics, chemistry, and other sciences, and there are so many elements of culture which he can put together into new combinations. Modern man would be a greater inventor than the cave man even if both had the same inherited mental ability, because in modern times there is more accumulated knowledge.¹

* * * * *

What does this analysis of Hart and others mean for us?

Waldemar Kaempffert, presently Science Editor of the New York Times, keynotes the meaning when he entitled his review of Hart's article: The Frightening Pace of Inventions.² Kaempffert quoted Hart's conclusion:

The SUPREMELY challenging fact is that the apparent sudden increase in the potential power of aggressors is only a spectacularly dramatic expansion of technological developments which have been slowly accelerating for hundreds of thousands of years, and which now have a speed of increase which threatens to disorganize civilization. Baffling as are the problems of these opening years in the Atomic Age, the fact of technological acceleration means that the problems of the future will keep on compounding and expanding until they wreck our world, or until organized intelligence applies science effectively to mastering the social problems which technological acceleration creates.³

Those who wanted a moratorium on science, that "Frankenstein's monster" were only reacting to this aspect of technological acceleration.

¹ Ogburn and Nimkoff, Sociology, op. cit., p. 791.

² The New York Times, Sunday, June 9, 1946, feature article of science section.

³ Ibid., also Hart's article, op. cit., p. 290.

Technological acceleration is thus a good candidate for nomination as the 'key long-term technological trend.' The idea is not new. Hundreds of scientists and commentators have expressed it in one way or another. Hart's presentation is given in such detail only because of its almost mathematical clarity, its dramatic expression of the forces driving scientific and technological frontiers ever-further into the unknown.

* * * * *

(b) The unification of the fields of scientific knowledge is a logical corollary to this basic long-term technological trend. Evidence exists to show that the progress of science has reached a point where data from each of the supposedly 'separate' 'sciences' overlaps. A unity of science, of the basic data upon which all applied-science achievements of technology are made, is being created:

A hundred years ago, physics consisted of six distinct sharply separated departments. Mechanics, Molecular Physics, Heat, Sound, Light, Electricity. The first partition between these compartments to be broken down completely was that between heat and molecular physics, when about 1850 heat was found to be not a substance, as had been supposed, but simply molecular motion.... (barriers between the other compartments have also been broken down)....What does all this mean? Simply that there is an interrelatedness, a unity, a oneness about the whole of nature.¹

This unity of basic scientific knowledge may be considered as a true qualitative change in the character of the physical

¹ Thornton, op. cit., p. 93. From an essay by Robert A. Millikan on The Alleged Sins of Science.

sciences. Instead of several disconnected fronts of scientific accomplishment we now have a single, rapidly advancing frontier. The more and more coherent body of scientific knowledge behind this frontier provides a ready base for driving ever-further into the unknown. Scientific progress, as well as technological advance, is thus being consolidated as part of a trend towards still further acceleration in achievement.

As an indication of the fields which may lie ahead for scientific progress, some commentators have speculated that

Is it at all likely in the light of that history
.....(the development of a unity in the physical
sciences).....that we can long maintain air-tight
compartments separating ether (or matter, whichever
you will) from life and mind?¹

This thought of unification between the biological and physical sciences opens up possibilities which defy human imagination. And yet the analysis of living matter into its chemical components, and the synthesis of near-living materials, is evidence that the biological and physical sciences are evolving ever closer to each other.

However the city planner deals primarily with man's environment, and therefore its physical technologies are his primary concern.

¹ Thornton, op. cit., p. 93.

(c) Creation of a 'surplus technology' is a second logical corollary to the basic long-term trends of technological and scientific acceleration. The Goodman brothers use this concept as basis for their curious half-physical-planning, half-philosophical planning text: Communitas

A surplus technology has the following characteristics: the capacity is well beyond what is necessary for the general security of life, subsistence; there is more than one way, there is a choice of ways, for carrying on major parts of production, and there is a fund of surplus goods and productivity to allow even major means of production to be temporarily idle for retooling and replanning.¹

The Goodman brothers accept as obvious, the fact that our present technology has already entered upon the stage where these things are true. We have a "surplus technology". We in the United States have such a great potential productive capacity that we are not even pressing against its limits in peacetime. Questions of the day are whether it is profitable to expand steel production and house building, not whether it is possible. We all know it is possible !

The Goodmans also point out the effect of our 'surplus technology' on city planning. It provides us with great possibilities for planning communities on a tremendous scale. It provides us with the potential ability to physically cope with the rapid rate of change in desirable city patterns due to rapid technological advances. We have the technological means of rebuilding

¹ Goodman, Percival; and Goodman, Paul. Communitas. The University of Chicago Press, Chicago, 1947. p. 10.

much of our cities every generation, if that becomes desirable.

* * * * *

Finally, a word of reconciliation between this new concept of "surplus technology" and the more orthodox concept of relative scarcity in manpower and materials. It is obviously true that we cannot exploit all the possibilities of science. We are ultimately limited by our physical resources.

Furthermore, we cannot junk all our methods of communication, junk all our houses, junk all our cities. But 'surplus technology' does not imply that we can. The trend towards surplus technology means merely that we have more and more leeway between our minimum requirements for subsistence and our total potential productive capacity. This leeway can be used for better human living conditions, IF ways are found to release the jammed floodgates of potential production.

Perhaps an illustration of our power to change our world would be useful. Before World War II it was calculated that we could replace all the power-producing machines in the United States for less than the 'money' figure of our national income for one year.¹

¹ Here is the calculation. Technological Trends, op. cit., p. 249, table 11, gives the total horsepower in the U.S.A. in 1935 as 1,230,816,000.

Assume the cost of a 100 hp engine at \$1,000.00, and larger engines in proportion; an assumption which



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Calculations like this illustrate the incredible potential productive power of our country's technology today. Every advance in non-organic power possibilities and every advance in 'pure science' should bring closer the day when our nation's productive power will be focussed on the wholesale re-creation of our outmoded, obsolete, inefficient city structures.

(d) A new level of technological prediction can be derived from the three long-term trends of technological acceleration, unification of science, and surplus technology. All three trends point to the idea that we have crossed the threshold of an age where, in the physical sciences at least, the wish is the command !

Some commentators now argue that today, instead of there being separate "technological trends", there is merely a vast field of "technological possibilities". We know so much about the non-organic potentialities of our world

(continued from last page)

is not out of line when we remember that 965,000,000 of the 1,230,816,000 total in the U.S.A. is represented by auto, bus, truck and motorcycle engines !

Then: one billion horsepower in engines would cost ten billion dollars. Ten billion dollars is less than ten per cent of the national income for one year.

Even assuming total horsepower in the U.S.A. has tripled since 1935, and even allowing a 100% margin for error, we could still replace all our engines for sixty billion dollars, or less than half of our national income.

Of course no such wholesale replacement in one year or even five years is practical. Machines make machines, and we must live too.....But... !

that we have the power to shape our future physical environment to meet our needs. We can call forth new inventions and new production as required ! And this long-term actuality does not conflict with previous statements regarding short-term technological prediction.

Let us consider these ideas one by one. The concept that we have entered an era in which real 'trends' no longer exist --- there being merely a vast field of technological potentialities --- was seen many years ago by some commentators. For example, Walter Lippmann in A Preface to Morals suggests

in modern types men have Invented A Method of Invention, they have discovered a method of discovery. Mechanical progress has ceased to be casual and accidental and has become systematic and cumulative.¹

Another commentator, John Herman Randall Jr., states the same point in a different way:

When once a civilization has accumulated the mechanical techniques that ours has, it seems to take only a sufficiently strong demand to call forth any conceivable needed invention.²

Hornell Hart's concept of technological acceleration provides further support for these views.

In fact the principle of the functionally equivalent invention (see above, page 34) begins to assume the status of a symbol. Take for example the case cited by Gilfillan in 1935 -- of predicting that the "great boggy of flight, fog

¹ Lippmann, Walter. A Preface to Morals, New York, The MacMillan Co., 1934. Chapter XII, p. 241.

² Thornton, op. cit., p. 193.

(which) has recently been or may soon be conquered by some of the 25 known means".¹ Since Gilfillan wrote an entirely new originaive invention has licked the fog bogey both on land and sea: RADAR.²

Secondly, we now know so much about science that we can actually specify what aspects of the field of technological potentialities shall be attacked. This is not to imply that we can govern the course of discovery in the 'pure sciences'. Nor can we change biological aspects of nature at will. But we can change the emphasis on how our knowledge of science is applied, can change the 'trends' in our technology. This means that if we want a given set of technological results, we should set up a system of incentives to insure technological research will be directed towards the ends we have in mind.

Indeed perhaps the primary lesson of World War II is the striking successes achieved by our scientists and engineers in creating new weapons for destruction. Unless

¹ National Resources Committee, Technological Trends, op. cit., p. 22. (Gilfillan's article on Prediction of Invention

² Radar now provides a screen upon which a pilot can see airplane runways just as they appear in full visibility. Its techniques are improving to where some day radar may equal television in image clarity ! See such recent patents as GE assigned 2,426,440, and Federal Telephone assigned 2,426,184 for typical details.

A revolution in piloting ships through fog was highlighted by the furor aroused in shipping circles when the 615 foot, radar equipped ore carrier A.H. Ferbert motored through Sault Ste. Marie while a thick fog immobilized sixty other large vessels. New York Times dispatch printed Nov. 25, 1946.

the incentives for technological research are directed towards more desirable human objectives we may all perish.

Thirdly, if these long-term technological trends point to an era in man's mastery over nature, point to a new era where the wish is the command; what happens to the prediction of inventions? Simply this. Short term prediction of inventions assumes that present conditions will continue unchanged. If present conditions call for more and more suburbs, sprawling outward from congested city centers, short term prediction is justifiably based on that trend. The applied-scientists of today direct their work toward objectives which are currently profitable for them and their employers. ('Profitable' here means the whole complex motivation pattern, ranging from idealistic drives and motives of revenge, such as those of German scientists here in the U.S.A. on war work, to sheer hope of pecuniary gain either in form of salaries or royalties.)

Now if the long-term trends of technology are ultimately used for planned satisfaction of man's desires, then man's mastery over nature will be extended to include a reorientation of applied science. Under such circumstances, and granting that we have entered on a new era where 'the wish is the command', short term prediction will become completely scientific. It will be merely a question of programming, of when and how the new creations to fit human needs will be forthcoming.

* * * * *

This has been an outline of teachings in the 'grammar-school' level of understanding impact of technological trends. Such a study provides us with a general groundwork of what science has achieved and can reasonably hope to achieve.

City planning cuts across many fields of endeavor -- Professor Martin Wagner of Harvard likens the art to that of an orchestra conductor: both planner and conductor need to know the general potentialities of many specialized fields in order to blend them into desirable creations. A general knowledge of technological developments is thus essential for the city planning technician.

We turn then from the 'grammar-school' level to consider the 'high-school' level of those objectives towards which the technological achievements of today and tomorrow should be directed.

SECTION 3. THE "HIGH-SCHOOL" LEVEL (Planning Objectives)

AMERICAN students and professionals in the city planning field frequently disagree on basic objectives for their profession. Apparently some accept varying degrees of identification between 'physical planning' or 'social planning' with city planning. Others seem to confuse the details of planning with planning as a whole --- confuse the trees with the forest !

The existence of this confusion has an obvious historical background which will not concern us here. However a common starting point for discussion of the 'high-school' level of planning objectives must be outlined. Therefore we begin with a few generally accepted postulates of desirable city planning. Then, using this as basis for judgement, some factors confusing the specific objectives of our profession can be outlined. And finally some basic considerations for the future science and art of city planning will be discussed.

* * * * *

A. PLANNING AS A DYNAMIC PROCESS

- (1) A simple definition of city planning:

City planning is an activity which efficiently improves the urban environment for living.

This definition of good city planning is a combination of several concepts, each of which will be considered separately.

(a) City planning as an activity emphasizes its continuing, dynamic qualities. Planning is a process which is never complete. Existing cities must be continually modified to meet changing social, political and technological actualities. New communities should be planned to anticipate technological potentialities. New communities will continue to require modification to meet changing conditions.

(b) City planning concerns primarily the urban environment. This is more than a physical concept, and it covers more than urban areas themselves. It involves social and psychological factors in the creation of both town and country environments. Benton MacKaye puts it this way:

It takes more than houses and streets and sewers to make a real community. It takes more than towns and railroads and cornfields to make a nation and a pleasant land to live in. These are enough for the 'material fact', but not for the 'spiritual form'. They are enough for a mechanical state of 'civilization', but not for a living 'culture'.....(Man) needs
....the right kind of environment.

Environment is to the would-be cultured man what air is to the animal --- it is the breath of life. ¹

¹ MacKaye, The New Exploration, op. cit., p. 29.

Of course this does not imply that city planning can create a harmonious and related environment by itself. That act of creation requires active democratic participation by all the people themselves. But planning can go a long way.

(c) City planning seeks to improve the urban environment for living. By 'living' we do not mean mere 'existence'—mere food, clothing, and shelter. We mean living in the sense Henry David Thoreau gives us when he grumbles

Most men, even in this comparatively free country, through mere ignorance and mistake, are so occupied with the factitious cares and superfluously coarse labors of life that its finer fruits cannot be plucked by them. Their fingers, from excessive toil, are too clumsy and tremble too much for that.....The finest qualities of our nature, like the bloom on fruits, can be preserved only by the most delicate handling.¹

Those who want real living must, like Thoreau, "want to live deep and suck out all the marrow of life....."², and must want to help others do likewise.

(d) Next, city planning seeks to improve the urban environment for living. Improve implies a sense of direction, a concept of progress. Effective city planning must be progressive, must continually be at work to make the urban living environment better. From this point of view,

¹ Thoreau, Henry David. Walden. Boston, Houghton, c. 1893, p. 12.

² Thoreau, (ibid). p. 143.

all but a handful of city planners in America are fighting a losing battle ! It appears fair to say that our cities, as well as many other aspects of our community life, have become worse places for people to live in during the past generation. The American watchwords of "bigger and better" are not synonymous with progress.

The clearing of the wilderness has brought farms where there were once wild beasts, but it has also brought more floods and more destruction of the soil. We are now a richer country than we were a hundred years ago, but is the acquisition of wealth progress? Jesus Christ inveighed against the rich of his day. We move about the earth in faster time, but does the motion bring more happiness or health or comfort or peace of mind? If our greater number of laws are accompanied by more crime, is that progress? ¹

Progress, therefore, implies a value judgement, not a mere quantitative statement. We have progressed, we have 'improved' the urban environment for living only when we have developed forms for living which help to satisfy a greater number of human needs.

Furthermore, if we wish to plan for the future we must foresee and provide for human needs which will become evident in the future ! This is what makes city planning in our present period of rapid social and technological change so difficult. What people want today is not what they wanted yesterday nor what they will want tomorrow. Until automobiles were cheap and 'accepted' men fought to keep

¹ Ogburn and Nimkoff, Sociology. op. cit., p. 904.

them from cluttering up the streets. Now we must replan our cities to make way for them.

If there had been city planners during the 19th century, one of their primary tasks would have been to foresee the obvious trends towards more and more railroad and road transportation, and to provide adequate avenues for them! Unfortunately 100 years ago there was practically no realization of city planning problems under a rapidly developing technology.

But the lesson is plain. City planners of today and tomorrow must profit from the mistakes of 19th century city fathers. We must foresee future demands for such things as television, the cheap family airplane, the cheap portable demountable sectional house -- and many other factors not yet recognized even by most planners as important considerations of city planning. We must provide for future as well as for present human needs, or we will plan not cities but monstrosities! Just how this may be done will be taken up in later sections of this study.

(e) Finally, we must reemphasize that the urban living environment is what we want to improve. This would scarcely seem worth mentioning were it not for the amazing number of city planners who have strayed from the best interests of their profession at this point. Those who 'plan for posterity' by promoting huge and inhuman plans, whether they be the dull, ridiculous and stereotyped

horizon-to-horizon gridiron street patterns of the 19th Century, or the gargantuan radial pattern of Pierre L'Enfant's Washington plan, or the 'patterns' of many low rent housing projects of our present day --- these people are forgetful of the human scale of planning. (Or perhaps they believe it 'does not pay'). They have been captivated by the techniques of mass production, of endless repetition; or else they plan 'monuments'. In either case they plan Procrustes' 'molds' for future development. Neither monuments nor the raw products of mass production are fit for people to live in.

To counteract this trend Henry Churchill felt it necessary to name his recent book "The City Is the People". Basically it is for human beings that we plan. Happy and contented human beings with opportunities to develop their capacities to their heart's content: these are the ends of our planning. Men and women, their children and their children's children up to the next hundred years or so: these are the critics whom the means of socially effective city planning must satisfy ! Realistic planning must begin and end with a human scale of values, and an understanding of what people want and what people need.

(2) TWO GUIDING PRINCIPLES for city planning as a dynamic activity may now be formulated. Both are generally

in line with views voiced by Henry David Thoreau, Patrick Geddes, Ebenezer Howard, Lewis Mumford, Benton MacKaye and others of like inclination towards a real philosophical approach towards better human living conditions.

(a) We seek to provide for the needs of all kinds of human beings. Each one of us must be able to feel that he or she is an end in his or her self: a complete, important individual. Each one of us must be able to keep self-respect in the presence of other individuals.

It is this obligation to maintain the worth and dignity of each and every human being that is behind our Constitution's opening phrase: "We the people". And this is what basically prompted the first ten Amendments to that Constitution, and also Amendments 13, 14, 15, and 19 -- all developing and making more explicit certain rights of "we the people".

(b) We seek to provide CREATIVE activities for all people. It is not enough to provide for the basic needs of people: for food, clothing, shelter. We must go further and provide opportunities for human expression which are capable of lifting people to higher levels of living. Such opportunities are both physical and mental. They include such things as the physical enjoyment of undisturbed nature on land and sea, the peace and quiet of farm and countryside, as contrasted with the bustle of city life; the infinite stimulations of active competitive sports. Likewise they

include equally creative but less physical activities such as reading, writing, acting, hobby-writing, studying. And to a lesser extent they include passive occupations of watching others perform, compete, or explore the unknown.

In other words we must not accept the minimum standards for life, no matter how high they may be. We must plan to provide ample opportunities for creative expression, so that the human spirit is freed to soar as high as it can.

Of course no one can be forced in our democracy to participate in active sports, hobbies, educational opportunities or other physical or mentally stimulating activities. But no one should ever be deprived of the opportunity to engage in such activities if he or she is so inclined.

* * * * *

With these principles we find a fresh approach to the problems of city planning. If people are to get the most out of living, steps must be taken to simplify and where possible eliminate the jarring discords of our present chaotic city and country environments.

If people are to get the most out of living, they must also be freed to expand their horizons, to explore the unknown,

to widen the "structurization of their life-space"¹.

And as part of this simplifying and enlarging process, mental and physical insecurity must be abolished. Further, all people must have both ample leisure time and the opportunities to make use of it, particularly if their work is uninspiring.

* * * * *

B. DIFFICULTIES IN DETERMINING PLANNING OBJECTIVES.

Granted that the general objectives of city planning are clear, that our approach must be through understanding and making effective -- socially important human needs:

We still have an almost insuperable obstacle ahead of us in determining detailed planning objectives. In our society the 'effective needs' are not the most important from a social point of view. By 'effective' needs' is simply meant the values of things expressed in terms of money. And for a number of reasons the money values of things are not the same as their socially important values.

Perhaps this point will be better understood if two principal objections to "effective" or money values of human needs are outlined. Then on the basis of this analysis we

¹ This is a psychological expression meaning to develop the whole personality of the individual by enriching his experiences from the world around him. A child learning to walk and talk is widening the 'structurization of his life space'. And an old couple finding rest and contentment among close friends and congenial surroundings is likewise widening the 'structurization of their life space'.

can indicate how city planners can really determine socially important needs.

(1) THE "CULTURAL PSEUDOMORPH" has been cited as the most significant source of error in money values of things from the city planning point of view. Lewis Mumford borrowed the concept from Oswald Spengler and adapted it to technological problems and city planning problems in particular.

Pseudomorph is a geological term by derivation. Some kinds of rocks have been found which retain their outward structure after most of their elements have been leached out and replaced by entirely different materials. Such a formation is known to geology as a pseudomorph. Petrified wood and many fossils are ex-organic forms of the same process. And a cultural pseudomorph:

A similar metamorphosis is possible in culture: new forces, activities, institutions, instead of crystallizing independently into their own appropriate forms, may creep into the structure of an existing civilization. This is perhaps the essential fact of our present situation.¹

With this concept in mind, Mumford suggests that the sum total of our inventive efforts of the past hundred years have merely gone to strengthen existing city forms:

For what has been the total result of all these great scientific discoveries and inventions, these more organic interests, these refinements and delicacies of technique? We have merely used our

¹ Mumford, Technics. op. cit., p 263-264.

new machines and energies to further processes which were begun under the auspices of capitalist and military enterprise: we have not yet utilized them to conquer these forms of enterprise and subdue them to more vital and humane purposes. The examples of pseudomorphic forms can be drawn from every department. In city growth, for instance, we have utilized electric and gasoline transportation to increase the congestion which was the original result of the capitalistic concentrations of coal and steam power: the new means have been used to extend the area and population of these inefficient and humanly defective metropolitan centers.¹

On a superficial level at least, this process of pseudomorphic development explains much that has actually happened.

Expanding Mumford's example:^{as} technological developments are put into use the easiest way is to fit them into what already exists. Automobiles clog downtown streets built for wagons and coaches. Slums are rebuilt ever higher in the same places. As transport on the street level in the bigger cities becomes too congested, technological advances are utilized to help it go overhead or burrow into subways. New type factories cluster near those built 50 years ago. And worst of all, the gigantic powers of technological progress make it POSSIBLE to keep on doing these same things INDEFINITELY. Old city forms thus corrupt the natural possibilities of new technics.

And our free enterprise economy, utilizing money prices to express human values and scorning central planning, is powerless to counteract these pseudomorphic tendencies !

¹

Ibid., p. 265.

We must either 'put up and shut up', or venture beyond present methods of determining the public interest and of controlling technological developments and city forms.

Indeed the cultural pseudomorph carries a warping influence into more than the physical aspects of our society. People get used to their surroundings. New things tend to frighten them with their possibly unknown angles. And thus city planners cannot rely heavily upon public opinion polls as a method of expressing even present needs of people. We cannot take present ideas of what people say ~~they~~ want as being 'final' so far as long-term city planning objectives are concerned. If people knew the whole story their ideas might well change.

* * * * *

(2) SOCIAL VALUES VERSUS MONEY VALUES: a second major force invalidating the concept of money as a good method of expressing socially important human needs, is simply that ~~our~~ society is not built that way. Being based on private enterprise, on capitalism, money values do not afford equal expression for the needs of rich and poor alike. Yet both are human beings for which good city planning must provide. Furthermore, since our society emphasizes private values as opposed to community and social values, many important things have no money value whatsoever !

Thus for example there are methods known of drastically

reducing the smoke and dust nuisances of our cities¹, of making all but the largest airplanes as quiet as automobiles,² of eliminating the inhuman crowding together of people in cities --- whence they flee at night to suburbs via overcrowded and unhealthy transport systems, of eliminating mechanical gridiron street patterns without losing the simplicity of the gridiron method of building and street numbering. Even the unhealthy concentration of carbon monoxide in our city streets could be greatly reduced by the simple innovation of engine exhausts discharging vertically upwards.

And all these examples are chosen from outside the realm of such 'uneconomic' but generally recognized social standards as good houses for all our families, good community facilities, and good parking facilities for private cars in city centers !

(3) BETTER WAYS TO EXPRESS HUMAN NEEDS: before city planning can progress very much further it must find new ways of determining socially important needs. Several possibilities present themselves: public opinion polls have some validity but the cultural pseudomorph may completely upset their results at least as a basis for long-range planning. Studies in group dynamics such as the work of the late Professor Kurt Lewin at M.I.T. may produce a higher

¹ National Resources Committee. Technological Trends, op. cit., p. 24-25.

² Recent objections to the private plane have stimulated research into lightweight plane mufflers and noiseless propellers. Every day new improvements are announced.

insight into what makes groups of people tick, and may serve to show where pseudomorphic tendencies exist.

Philosophical analysis of what is 'good for people' according to this or ~~that~~ line of reasoning, undoubtedly provides a guide to possibilities. Such studies might be combined with experiments in group dynamics to produce among an 'educated' population a closer approximation to the unbiassed reality of social needs ! And so forth: the field is wide open.

One factor must never be forgotten. On the one hand we have what people 'want' today, according to their best judgements and present information. On the other hand we have the elusive concept of what people would want if they knew it existed ! Faced with these alternatives, the city planner must undoubtedly want to influence present desires of people along what are considered constructive lines. But there are all sorts of people. They have all kinds of desires. The city planner must never assume; we as city planners must never assume, that what WE think is best is the only good solution ! For after all we build for people, and they must be satisfied. The road to hell is paved with good intentions.

This leads to a second observation. Political action to obtain planning results is perhaps the best way of (a) determining workable planning principles and schemes, and (b) putting them into effect ! The British Labor Party's

action to promote planning seems to have helped their candidates at the polls AND seems to have aroused public support and public debate. All of these things help.

* * * * *

C. TOWARDS A TECHNOLOGY OF CITY PLANNING

We defined a science as any body of systematized knowledge. And we defined technology as applied science, or more specifically, applied industrial science. City planning certainly should be brought in under these definitions; giving us a 'science of city planning' and a 'technology of city planning'. But if we allow this kind of mental gymnastics we must certainly recognize that both the 'science' and the 'technology' are infants today.

(1) TEMPORARY PROMOTIONAL CHARACTER OF CITY PLANNING

Much of what we have considered in defining objectives of planning can obviously have validity only when a real 'science' of city planning exists, and when a real 'technology' of planning has been created upon it.

In this case, is the approach here useful in our planning activities of today? And if so, in what ways can it help to create a true science and technology of planning?

Answers to these questions are too big for this

essay. But a few observations may be in order.

For the question of usefulness, the answer is that each, ~~would-be city planner~~, must work towards that time when city planning WILL be a science (a) capable of shaping technological potentialities to meet human needs, and (b) supported by so many people that its democratically determined programs are rapidly translated into democratically approved action.¹

Until city planning becomes a recognized science with its own heirarchy of research institutions and its own arrangements for effective execution on each level of governmental activity, until that time city planning remains largely a promotional business. And promotion the world over is a catch-as-catch can business. If real progress is to be made towards improving the urban environment for living, the process of city planning must be continually expanded, expanded towards objectives of our profession !

(2) THE TWO LEVELS OF HUMAN RELATIONSHIPS

We may next ask: where should we begin in building a true "science of city planning"? The first steps must be to

¹ In an earlier paper entitled "Business, Psychology, and Better Planning", M.I.T. September 1946, I attempted to show how this must eventually be accomplished, primarily through arousing the interests of those groups and organizations who stand to gain the MOST from decent urban living environments. Only when a very large percentage of the 'men and women in the streets' know what planning is and make an effort to achieve it, only then will planning become a real force in America !

establish a framework upon which to orient city planning designs. Now as we have assumed that city planning must express socially desirable human needs, this framework must obviously be based upon and EMPHASIZE human needs.

It seems to the author that human needs must always be considered on an individual, a human scale, and that human relationships must always be considered on TWO levels; the extensive and the intensive.

Intensive human relations are cultivated on a geographical or spacial basis: the home, the neighborhood, the neighborhood school. Man has banded in social groups which depend on the intensive level of human relationships ever since he graduated to the level of a social animal, perhaps a million years ago.

This is the level of close and continual human contact --
-- an essential of social intercourse.

Extensive human relationships have developed between people with special interests in common. Groups of professional people; groups of students, of mothers, of parents, of elderly people; groups of employers and groups of workers; groups of people sharing the same religion; groups of sports enthusiasts of all kinds: all these have as their basis some special interests which they hold in common.

But living in the same family or neighborhood may also be considered as a 'special interest in common'. So these

groups have something else to distinguish them. The name gives the clue. Extensive human relationships hold good regardless of where individual members of the group live! Chess players cross the so-called 'iron curtain' in Europe with impunity.

What is the value of these 'extensive relationships'? By their association together, the members of extensive groups achieve higher levels of creative accomplishment than would otherwise be possible. A firm pattern of extensive relationships is essential to the unofficial but non-the-less real international fraternity of fundamental scientific research workers which has made our present technologies possible.

Furthermore we may note that the extensive level of human relationships is a vital cornerstone of big-city development. For cities provide more opportunities to form groups of people with like special interests; And such groups attract people to them once they have formed.

However, face-to-face discussions as a method of group communication appear likely to wane, and swift transportation methods make distance less of an obstacle; so this factor in city development seems destined to diminish in importance.

* * * * *

Both the extensive and the intensive levels of human relations must be maintained and developed by city planning for the future. This is important because good city planning must facilitate these types of human needs through proper physical frameworks.

In this connection it is worth remembering that important national organizations which embrace more than one 'extensive' grouping, provide for two distinct heirarchies of relationships between their members. The Army has its general chain of command linking the different levels of 'intensive' groups: squad, company battalion,--- and its special staff chain of command linking specialist troops by their branch of service regardless of geographical location.

The AF of L and the CIO have national unions, each embracing workers in a specific craft or industry; and councils, each embracing all the locals in a given area regardless of the craft or industry^{to} which they owe national allegiance. Matters of relationships between the locals of an area are handled by the 'councils'. Matters concerning all the locals of a particular skill are handled through the 'national office'. Dues, that power which makes the wheels go round, are paid both to 'councils' and to 'national offices' by the member locals. And representatives are naturally elected to each by the locals.

And in city planning there must likewise be an explicit

recognition of this dual affiliation of modern man with his society. We must recognize and provide for the separate, intensive interests which bind homes and communities of homes together by binding the people in those homes together. And we must recognize the separate, extensive interests which bind certain groups and individuals everywhere -- in towns, cities, regions, nations and the world -- together.

We shall see in section 6 below, how this analysis provides the key principle necessary for building the future rational city structures based on human needs. Human needs can be determined for, separated out on the basis of, and applied to the different levels of city planning which emerge from application of this principle.

* * * * *

Enough has been said to outline the scope of the 'high-school' level of understanding. It should provide us with a clear sense of direction, of the general objectives which we seek. It should also show us the pitfalls in determining socially important human needs. And finally, it should help us see where and how a 'science' and a 'technology' of city planning may someday be developed.

And with a clear sense of direction for our planning, we should be able to understand how to make the best use out of technological possibilities for our profession.

SECTION 4: THE 'UNIVERSITY' LEVEL (Synthesis)

HOW can we make the best use of technological possibilities for city planning?

This is the key problem posed by the 'university' level of understanding. It concerns ways of joining technological means with planning objectives.

The paragraphs that follow are limited to outlining a few technical elements of this synthesizing process. For we must recognize that only the surface of the 'university' level can be scratched at this time. The socio-political questions stirred up by practical action are too involved. And definite answers for many phases of this 'level' require an accumulation of non-existent actual experience !

Points covered in this section will be:

- A. General aspects of positive planning for control of technology
 - (1) Positive Planning IS required.
 - (2) Begin with the 'ideal'.
 - (3) The 'science of planning'.
- B. The elements of positive planning as a science.
 - (1) Policy making.
 - (2) Research: two aspects.
 - (3) Execution.
- C. Prediction, and the Art of city planning.
- D. Summary.

* * * * *

A. GENERAL ASPECTS OF POSITIVE PLANNING FOR CONTROL OF TECHNOLOGY.

(1) THE NEED FOR POSITIVE PLANNING. The 'university' level as conceived by this study is useless without positive planning action. For only through positive planning action can the potentialities of technological progress be focussed effectively on the socially important ends of city planning. This presumption was indicated in Part I above, page 14.

Indeed it is fair to suggest that only through positive planned direction of municipal activities can ANY real city planning be carried out. The problems of expressing city planning objectives in terms of money, the problems of pseudomorphic development of our culture, the problems of rapid change due to expansion and new technological elements -- all require far-sighted master planning and continued vigorous community action.

A glimpse at the vast socio-political problems involved will indicate why these problems cannot be considered here. Writing on Technology and Government Change, Professor Ogburn concludes:

Some government structures are an unusual obstacle to change. Meanwhile technology develops, is let loose on society, sweeping all before it. Time on the clock

of technology cannot be turned back. We cannot return to the stone age nor to the horse and buggy, nor to the plantation days of a rural economy. Technology rolls on like a huge tidal wave, while governmental structures stand like the rock of ages in a world of disorder -- an irresistible force meeting an immovable object.....The Constitution is amended from time to time, and new administrative bodies do develop and even exercise legislative functions. But the tragedy lies in the delay....¹

To meet this modern dilemma new methods are necessary in government as well as in technology. New paths must be blazed through our existing governmental setup. This study can at best consider only a few of the technical details in the necessary solution.

(2) BEGIN WITH THE 'IDEAL' ! The first element in positive planning of any sort is in knowing where we want to go, what are the concrete objectives. In formulating these objectives we can borrow an extremely useful concept recommended by American business leaders for dealing with technological problems:

THE IDEAL VERSUS THE PRACTICAL IN LAYOUT

- A. The initial suggestion should represent a theoretically ideal layout, irrespective of cost. Frequently costs are less than originally anticipated.
- B. Subsequent adjustments may then be made until the point of optimum value between gains and costs is obtained.²

¹ Thornton, op. cit., p. 433. Also Technological Trends and National Policy, p 36ff, further elaborates this thesis with concrete examples.

² From Business and Engineering Administration course notes; Course 15.70: Production, Plant Layout section. By Prof. Erwin H. Schell, fall semester 1946. M.I.T., Cambridge, Mass.

This statement by the Professor in charge of the Department of Business Administration at that paragon of American technical schools, M.I.T., is indicative of a method of thought that has found expression elsewhere than in the hands of ivory-tower theorists ! Start with the ideal. Start with the best possible technologically conceivable scheme. This gives you the objective. Then --- even if this ideal layout is impractical by virtue of being too costly, at least you know what you are giving up, and you have had to estimate the relative costs of giving it up. And you may well, after having explored the possibilities, leave room for future developments and even hasten their coming.

City planners everywhere would do well to remember this approach for another reason as well -- a psychological reason. Too often we have compromised our positions in pressing for our plans. We forget the plea of Daniel Burnham:

Make no little plans; they have no magic to stir men's blood, and probably themselves will not be realized. Make big plans: aim high in hope and work, remembering that a noble, logical diagram, once recorded, will never die, but long after we are gone will be a living thing, asserting itself with ever growing insistency.

Thus a bold approach has three advantages. It highlights the sins of the past -- through comparisons. It breaks through the 'present pseudomorph' and demonstrates the new potentialities of our age. And it has the added quality of 'magic to stir men's blood'.

(3) THE 'SCIENCE OF PLANNING'. In the 'grammar-school' level section was indicated the basis for a NEW approach to the problems of improving the urban environment for living. This NEW approach would utilize the potentialities of applied scientific knowledge. Its capacity to solve the problems of city planning in the long run is **TECHNICALLY UNLIMITED !** We can count on the possibility of developing adequate technical answers for our city planning problems.

The problem therefore hinges on determining socially important human needs and in putting them into effect as guiding principles for actual construction.

Well, if a solution lies in the potentialities of science being **PLANNED** towards the 'ideal' objectives, what about the science of planning? Do we know enough, can we learn enough, to make positively and consciously directed planned action serve our purposes?

On a technical level at least, the answer is an unqualified YES. Here are some of the reasons for this assertion.

First, planning is in itself a science:

Like any technology, planning is politically and ethically neutral. It is an impartial spectator of party battles and is neither good nor bad per se. Its aims are not implicit in the process itself, but are set for it by the surrounding culture.¹

¹ Galloway, George B. and associates. Planning for America. New York, Henry Holt and Co., 1941. p. 7.

And, as basis for his symposium PLANNING FOR AMERICA, Galloway provides the following definition for this technology of planning:

Planning is the opposite of improvising. In simple terms it is organized foresight plus corrective hindsight. It takes all public problems for its province and pertains to all the problems of government, economy, and society. It involves the cooperation of all the social, physical and natural sciences. Conceived as a process, planning embraces a series of steps:

1. The determination of objectives to be sought
2. Research - to understand the problem.
3. The discovery of alternative solutions.
4. Policy-making -- choosing between alternatives, including the frequent choice of doing nothing.
5. The detailed execution of the chosen alternative -- known in physical planning as layout or design.¹

Thus if we follow this authority, planning is a science and a technology -- or can be elevated to that station.

Second, despite numerous partisan allegations to the contrary, planning can be democratic. Or more strictly speaking, planning of whatever type is neutral, just as the process of democratic action is neutral. Both planning and democracy are but means to achieve ends; they are methods and not ends in themselves. Their 'ends' are not postulated. Democracy provides a procedure for determining the will of the people. Planning provides a procedure for carrying out the will of the people. Both can be properly or improperly used.

¹ Ibid., pp 5-7.

In fact most of the partisan objections to 'planning' can be explained by a rather simple distinction between different 'levels' of planning. (a) When individuals plan their own future actions; or when cities, industrial enterprises, states or nations plan their future actions; the type of planning involved is obviously positive. For in all of these examples of planning organizations there is a positive and direct control being exercised over relations of things for the organizations' own welfare. (b) But when the planning of cities, regions or economic systems is determined through summation of thousands of individual positive planning actions (according to the theories of *laissez-faire*, 'equilibrium', 'free private enterprise' or what have you), then the type of planning involved can be called atomistic or 'negative'. In these situations there is no overall, positive direction for activity. The course of planning is not under control by any one person or political entity.

Now granted that in theory such negative planning would provide for the greatest possible freedom of individuals without damage to the ultimate social patterns achieved as a result of everybody's individual and private decisions. But in practice, so far as any kind of spacial planning is concerned, sole reliance on negative planning leads only to chaotic conditions. There are many reasons for this, as were seen in Part I. Technological changes themselves introduce such a large measure of movement that the theoretical 'equilibrium' theories find no basis in fact. And everyone

recognizes that the efficient/locations for highways, parks, schools, railways and residential areas are not determined solely by negative planning.

E Even zoning is insufficient. For zoning is usually only an attempt to preserve the character of what already exists. And even in those rare cases where development of open areas is guided by zoning, or where retroactive zoning has been enforced, it provides but a tool for guidance of private interests within a framework of streets and utilities established by other and more positive planning methods (though not necessarily better ones).

Now for the source of partisan objections to planning. We must recognize that there will always be squawks under any kind of planning, positive or negative. The desires of the "system" or the community must frequently run counter to individual interests. A real estate promoter who wants to develop his swamp for residence, a garage promoter and even a rolling mill owner who wants to develop new facilities must be made to recognize that considerations of community welfare come before their private interests. Democratic processes can and should insure that the real community interests win out over the special partisan interests of such individuals.

But under 'negative' planning, the squawks of interested individuals are dashed against the impartial "system". It is not some individual or organization which

is ultimately 'doing me dirt'.

Thus the first difference between the two kinds of planning is that positive planning always involves some 'higher-up' individual or organization who must by necessity bear the brunt of individual complaints ! Squawks can be focussed on someone or something definite, even though democratic action determined the objectives for the protested planning action.

The second difference lies in the fundamental results of the two kinds of planning. As noted above, negative planning frequently arouses justified complaints (from the community welfare viewpoint), yet the haphazard nature of the 'planning' admits no court of appeals short of legislative action to institute positive planning ! Under positive planning there is the presumption that complaints are probably not in the public interest, yet the courts provide a system where objections can be analyzed by a rule of law. In this respect 'positive planning' is more truly democratic despite its so-called 'dictatorial nature'.

The decision of almost all experts in city planning has therefore been in favor of positive planning. The freely determined results of laissez-faire, negative planning may mean individual 'freedom of action', but they also mean unplanned general patterns of growth disastrous for our cities.

* * * * *

A third, technical reason why positive planning can serve our purposes is that technological developments have made it possible to say: 'the bigger the planning unit the more efficient it can be' !

Professor Erwin H. Schell of M.I.T., for example, has indicated that in his estimation the sciences of business management and organization have progressed to a point where the economies of more effective planning in larger scale enterprises outweigh the problems of control over widely scattered units of the enterprise ! Modern technology has achieved, by such methods as analysis of plant function, rapid transportation and communication, cost accounting and extensive use of business machines; an efficient way of controlling activities of any sized industrial operation.¹

Now if huge-scale planning in the intensely developed and active fields of industrial enterprise pays off, then there can be no question about the efficiency and necessity of planning for the relatively slow-moving spacial relationships covered by city and regional planning. Coordination of land use and transportation would be valuable regardless of whether it were possible to show that in the industrial field the 'bigger the planning unit, the more efficient it can be'.

I

From class notes in Professor Schell's course: 15.72: Technique of Executive Control. Many other studious works have skirted around the edges of this pregnant proposition, that in industry the larger units for planning are often more efficient -- even if the excesses of monopoly and cartellization are discounted. For example see Professor Arthur Robert Burn's Decline of Competition, op. cit., passim.

B. THE ELEMENTS OF POSITIVE PLANNING AS A SCIENCE.

The following principles are outlined in one part or another of Planning for America and other current works.

There are three basic levels of planning activity as set forth in the definition of planning previously cited (page 95 above). These are policy making, research, and execution.

(1) POLICY MAKING in American planning has two significant aspects: the determination of basic objectives for applied research, and the choosing between alternatives disclosed by research as a prelude to actual building. Both of these aspects should be arrived at by democratic processes which are sufficiently representative to reflect the true social values and needs of all human beings.

Both require profound changes, even in our structure of government, before they can be truly democratic and efficient guides for technological progress (see Ogburn quotation, p. 91-92). Some examples of necessary changes in both National and local governmental structures are indicated on following pages.

(2) RESEARCH for city planning in America also has two aspects: (a) 'applied research' (parallel to applied

research in the physical science fields, outlined on page 29 above), (b) "city planning design and engineering".

(a) Applied research for city planning is on the level of aims, objectives, and generally desirable standards for detailed planning. It is properly a national function. Technological Trends and National Policy recognizes the need for an overall planning board whose functions would include those of 'applied research' for city planning:

The most important general conclusion to be drawn from these studies is the continuing growth of the already high and rapidly developing technology in the social structure of the Nation, and hence the hazard of any planning that does not take this fact into consideration. This pervasive inter-relationship so clearly manifest throughout the pages of this report points to one great need, namely a permanent overall planning board.... (italics mine)¹

The character of this proposed overall planning board must, however, be clarified. It could function on either or both of two different levels of activity.

The elementary level of activity would be just to continue and expand the type of service performed by the now defunct National Resources Planning Board. This would be merely correlating and periodically publishing analytical predictions of the anticipated effects of currently known

¹

National Resources Committee, Technological Trends, op. cit., p. viii (recommendations of the report).

inventions, as a guide and service to planners everywhere. In fact, in the absence of such an organization, the task is not beyond the scope of the American Society of Planning Officials or the American Institute of Planners. Such a service would be valuable, as we have seen that technological advances can be predicted with fair accuracy for up to 30 years into the future.

However, a second and much more comprehensive kind of overall planning for technological progress is necessary if our cities are to become better places to live in. The basic problem facing far-sighted city planners everywhere is that the building and rebuilding of our cities is not an 'economic' proposition. It costs too much to tear down outmoded buildings, rebuild or remove outmoded transportation ways and transportation terminals (including parking spaces). Good playgrounds for youngsters and good homes for old folks are not 'paying propositions'. Therefore just HOW the new city forms will emerge from the bewildering and uncharted array of technological possibilities is uncertain. No sure channel for progress exists.

Furthermore, technological research in America today already has a 'direction' imposed on it. Occasionally this direction is government inspired, as in the case of TVA and the Manhattan project laboratories. But usually it is industry-inspired, especially in the fields of applied

science:

Research, which includes invention, is now conducted in industrial laboratories. Scientists and engineers work in groups. They are competantly directed. They follow a plan....¹

Both of these considerations point to the necessity for an entirely new setup of planned research facilities; new laboratories developing scientific applications to meet human needs. As was noted previously there are thousands of such needs not now adequately studied by industrially sponsored research facilities. Among them are most aspects of soil conservation, smoke abatement, noise control; inexpensive utility and home construction; social studies of standards for public structures; economic studies on standardization of building materials to cut costs.

Thus the second aspect or level of research for city planning must go beyond mere prediction. New, planned research facilities must be created by national authority and given the job of producing desired developments ! This is but one part of the necessary positive approach to city planning problems -- but it is a fundamental part. Without properly designed technological elements, the costs of building and rebuilding our cities will never be reduced. And our cities will be remodeled 'too little and too late.'

¹ Kaempffert, op. cit., p. 243. See also previous discussion of this point, p. 30 and 34ff above.

A few scattered examples of such research organizations already exist in the American planning field. The Bemis Foundation, and the John B. Pierce Foundation at Yale are examples. The Pierce Foundation has been scratching the surface of new methods in housing construction -- insulation, fluid heat for all purposes including cooking, etc..

In the national field, President Truman's Scientific Research Board has recommended "a program for bold and imaginative expansion of scientific research, entailing annual expenditures of at least one per cent of the national income by 1957"¹ This rate of scientific research would be double the present rate of public and private research, of approximately one billion dollars yearly. It would involve national scientific grants and national planning of research endeavor. Such a program could be of vital assistance in positive planning of technological developments to aid city planning problems -- if it were directed towards those problems.

* * * * *

(b) Research in city 'design' or 'engineering' is the second aspect of city planning research. The present practice in America is not too unsatisfactory in this respect so far as it goes. Today, the application and coordination

¹

New York Times, dispatch published 28 August 1947.

of achievements in the applied sciences is usually reserved to the local planning departments or commissions. The community planning agencies mold available techniques and materials into local environments -- in theory at least.

Here the concepts of "research" by planning staffs that Robert A. Walker sets forth in The Planning Function In Urban Government begin to apply

As an integral part of an administrative structure the functions of a planning staff are broadly twofold: (1) to carry on research and to make recommendations on the basis thereof, and (2) to coordinate departmental policy planning¹ (*italics mine*)

This is the detailed application of planning standards and potentialities of technology to specific local situations.

It may be questioned whether this concept of research into the problems of the individual community is adequate or efficient. For the tremendous complexities of city planning today require large staffs of experts, which even most cities cannot afford.

Probably a system of regional planning staffs providing technical assistance to individual cities and towns, in some such way as the T.V.A. does now, will provide a better method of planning research into individual town and city practice of planning. And such regional planning staffs should be under a national town and country planning agency

¹ Walker, Robert A. The Planning Function in Urban Government. Chicago, University of Chicago Press, 1941. p. 171.

such as appears to be developing in England. The real research function would therefore be partly removed from the local administrative structure.

(3) EXECUTION, the third basic level of planning activity, may also be divided into its local and national functional aspects. The local 'on the site' level must be primarily a product of local desires and initiatives. National standards in matters of local concern should only be enforced on localities when 'local matters' have direct effects on higher levels of planning. Thus for example, national highway and airport, health and safety standards must be respected locally. Local initiative, local expressions of individuality, should always be encouraged in all other spheres of action. 'Local color' is a desirable trait that no national organization can furnish. It comes from the plans and hopes of communities themselves.

Execution of planning measures is a problem of such tremendous complexity that its details cannot be covered here. However two principles of such execution are worth noting. First, once policy has been democratically determined, expeditious action to carry out that policy is indicated. Shortcuts must be found to reduce the delaying effects of special interest groups, groups which by their nature must usually put their own welfare above that of the community. Second, execution is a many-sided

proposition involving a high degree of organizational skill and the other attributes of successful business enterprise. It requires cooperation of several levels of government; national, regional, and local. It involves a tremendous and continuing organization, many lifetimes of work, a never-ending job !

C. PREDICTION, and the ART OF CITY PLANNING

It was previously pointed out that so long as planning does not have its own heirarchy of research institutions and its own arrangements for effective support and execution on each level of governmental activity, we will have only promotional planning. (page 84-85)

In the future, after our social and political institutions have been streamlined to meet the blasts of social change -- enough at least to admit such things as a science of city planning--: prediction will be come routine. A real technology of planning, backed up by efficient democratic organs of execution, will be able to improve the urban environment for living by molding technological potentialities to fit planning objectives. Thus the present-day problems of predicting social impacts of inventions, and of providing for them in relatively inflexible physical plans, would be virtually eliminated.

In passing we should also note that mastery of city planning as a 'science', as a systematized body of knowledge, shades imperceptibly into mastery of city planning as an art. The aesthetics of form and structure, of buildings and the spaces around them, of individuals and the communities they form, of places for work and rest and play: knowledge of these things requires knowledge of what we have to work with, and what we can do, and how we go about it. Dreamers can visualize castles in the clouds, but without the aid of modern technology those castles would be mighty unpleasant to live in even if built.

* * * * *

D. SUMMARY

Part II of this essay presents a way of understanding technological trends and their effect on city planning through study of three successively higher 'levels'. Conclusions of this approach may be summarized briefly as follows:

(1) Our technological development has progressed to where 'we have invented a method of inventing'. In the long run we are faced with an infinite array of technological possibilities, from which we must select those to be developed for the benefit of mankind.

To understand his situation requires in the first place

a knowledge of the processes of invention; its evolutionary character, its distinction between 'originative' and 'intensive' or labor-saving inventions. Based on this knowledge, and on a general groundwork of what science has achieved and may expect to achieve in the future by development of known potentialities, we have been able to reach the 'grammar school' level of understanding. We can evaluate the effects of a given invention or cluster of inventions upon our work.

(2) But this basic groundwork will not lead us to socially desirable objectives since the infinite array of technological potentialities presents us with too many undesirable trends. We must study the human needs, the ENDS which all our planning must seek to satisfy. And if we recognize the necessity of seeing to it that each individual is considered an end, an entity worthy of respect; and if we recognize the validity of the two levels of human social relationships, the extensive and the intensive; then we will be able to set up rational city planning forms to meet and satisfy those human needs. This groundwork in human needs can provide social direction to technological progress.

The unfolding of the ends towards which technology should be directed may be termed the 'high-school' level of understanding.

(3) Finally we arrive at the third or 'university'

level of understanding. We recognize that knowing the technological means and the planning objectives for our work is not enough. Planning is useless unless it leads to action.

And we can sketch in some technical essentials of the necessary technology of planning: policy making, research, and execution. Large scale planning in general, and proper utilization of the potentialities of technology in particular, require their development.

WHEN we get a technology of planning cities, WHEN we are able to add to a 'grammar-school' and 'high-school' level of understanding a real 'university' level of positive inspiration for technological development --- THEN the problems of city planning in a dynamic changing world will gradually melt away. We will be able to look ahead and plan ahead. We will be able to act in the best interests of improving the urban environment for living.

PART III: APPLICATION

THE approach to problems created by technology which was outlined and discussed in part II, is illustrated in part III.

However because we need a 'technology of planning', only a thumbnail sketch of possibilities is practical. Material presented is divided along lines indicated by the last section. Section 5 covers four all-important short-term trends in recent technological development. These might be termed 'conclusions' which may be reached on the 'grammar-school level of study.

Section 6 rapidly sketches out what (to the author) appears to be the key overall pattern of human needs as expressed in city planning forms. These predominantly psychological and philosophical conclusions constitute an essay into concrete expression on the 'high-school' level of study.

Finally, in section 7, a few remarks will be made on the 'university' level of understanding.

* * * * *

SECTION 7. THE "GRAMMAR-SCHOOL" LEVEL (4 Trends)

THE first step in dealing with short-term trends in technological progress is to simplify the confusing array of possibilities. This simplification is no mean job. It entails an accurate appraisal of the value, for the profession of city planning, of various actual and potential developments. However, based on a previous study¹ and some other considerations which will appear in the course of analyzing the selected trends, the author notes four especially significant technological trends:

- A. The trend towards a comprehensive transportation network
- B. The trend towards integration and lower costs of mass-produced power
- C. The trend of forces affecting industrial size and location (new forces favoring the planned decentralization of industry)
- D. The decreasing relative costs of new construction

Before discussing these trends more fully it is worth reemphasizing that these are NOT the only possible major trends, nor necessarily the most important ones for planning. The brief factual framework of technological possibilities, presented on pages 44 to 48 above, is an indication of the possible range. Scientific research would undoubtedly develop more and more important trends for city planning

¹ Willcox, Roger. Replanning Problems of New York City's Lower East Side. Cambridge, Mass., (an essay for partial fulfillment of requirements for BS in Economics, Harvard University). 1941.

than those to be discussed here.

* * * * *

A. THE MEANS OF TRANSPORTATION BECOME DIVERSIFIED.

Our transportation methods have been expanded until today they include travel by land, sea and air. Further, the essential limitations of each type of travel are fairly well established.¹ The resistance of water to objects moving through it increases roughly as the cube of the speed, this inherent limitation of water travel appears too expensive to overcome.² With this limitation in mind, water transport appears properly confined to movement of bulky and heavy commodities --- where time is of lesser importance and where costs per ton must be kept down. Water travel is extremely flexible as long as rivers or harbors are available. Long canals are possible, the eotechnic phase saw thousands of miles of them in use, but they cost too much for general use today.

Land travel is becoming completely flexible. That is, the costs of moving materials and goods from any point to any other point across land surfaces are being equalized. An equilibrium between rail, bus, truck, and automobile is being reached. Railways in the face of truck competition are gradually limiting their activities to

¹ Annals of the American Academy of Political and Social Science, Volume 242, Building the Future City. Philadelphia, The Academy, 1945. pp 53-67 gives a good account.

² Gilfillan, Inventing the Ship, op. cit., pp 211 ff.

the continuous flow of heavy, low-value, bulk commodities: coal, ore, lumber, grain, from concentrated points of origin to large terminals and consumers, in trainload, or at least carload quantities, for which switching and classification delays and charges will be minimized.¹

Railway passenger service will undoubtedly not be eliminated but it faces serious competition from bus and automobile for short hauls, and from the airplane for long hauls. A secondary and 'stand-by' role is indicated except where special conditions apply, as for instance the possibility of overnight sleeper runs between large cities and swift commuter service into central cities like New York.

Automobile and bus travel is also shaking down into a pattern for the future. The trend in car ownership is approaching one car for a family, it may approach a nationwide saturation point of one car per two adults; a figure already approached in such places as Los Angeles where a ratio of one car per 2.3 people has been reached.²

The extreme flexibility of the automobile is its chief asset, provided that suitable highways and parking facilities exist. However neither the automobile nor the bus seem to stand a chance against the airplane except in travel under 200 miles radius.

¹ Annals, op. cit., p. 54.

². Lecture to M.I.T. Department of City Planning Students, 15 October 1946, by Mr. Gordon Wittnall, ex-chief of the Los Angeles Plan Commission.

Air travel is also showing signs of developing complete flexibility. Although here the modes of development are still highly dynamic, fluid, certain trends are emerging.¹ In broad outline from the planners' viewpoint, there appear to be the following different functional developments:

- (a) Helicopter flight from small fields and rooftops, for passenger shuttle service to larger fields², commuter and recreational private flying, and delivery of mail, parcel post, etc.,³ but helicopters have definite size and speed restrictions which counteract their ability to land anywhere.
- (b) Light-planes, appear to be developing to meet the same needs, but because they require larger landing fields and have faster rates of travel, their use will not be the same. At present they cost less but are not so flexible as helicopters.⁴ They may be almost entirely replaced by helicopters except for cross-country private flying.
- (c) Commercial, both scheduled and non-scheduled, passenger and cargo, are sure of rapid development despite the unfavorable reports on this year's profits (1946)⁵
- (d) Special-purpose planes, international and rocket planes are all emerging into prominence. The huge trans-oceanic planes require special landing fields. Rocket travel, and in fact most other long-range

¹ See Foresch, Charles and Walther Prokosch. Airport Planning New York, John Wiley & Sons, Inc., 1946. Also Ogburn, W. F. Social Effects of Aviation, Boston, Houghton Mifflin Co., 1946.

² Foresch, op. cit., p. 40. Greyhound Bus Co is experimenting.

³ New York Times WASHINGTON, Dec 18, 1946: "Air Parcel Post to be tested after helicopter shuttle trials." July 16, 1946: "Commuter Air Lines here backed by Examiners in report to CAB," etc..

⁴ New York Times Feature Article, Sunday 17 Nov 1946: "Light Plane Manufacturers Plan for 1947 but future of industry is uncertain.

⁵ New York Times, WASHINGTON Jan 9, 1947: Aviation Profits Cut 89% in Year. (They have since regained ground, and leading companies are asking for rate reductions !)

plane travel awaits development of atomic-power engines for really successful work.¹

Air travel can unquestionably be made just as foolproof as any form of land travel. In fact it is safer than automobile travel already: the 1946 fatality rate per 100,000,000 passenger miles on commercial aircraft was only 1.24, compared with the automobile rate of 9.8 (in vehicle miles; this must be reduced to about 4.0 to convert to passenger miles)².

Furthermore, the major objection of city-planners to the airplanes, their noise, is also on the way to solution since plane designers have recognized the necessity to do something about it.³

As a generalization then, this discussion supports the contention that each of the various modes of travel is gradually achieving a regularized status, based on differentiated needs in the face of costs. The steamship

¹ Fairchild Aircraft Company is already conducting research at Oak Ridge towards this "theoretically" feasible objective. See also, National Committee on Atomic Information (NCAI) Atomic Information, Vol. 1. No. 12. page 9 which mentions this development and explains it. Also: New York Times Aviation column, Nov 24, 1946, Jet-Propelled Passenger Planes are not expected to be ready before 1951, none being built now.

² New York Times WASHINGTON Jan 9, 1947 dispatch printed 10 Jan 1947: Aviation Profits Cut 89% in Year summarizes aviation CAB statistics for 1946 and compares them with the 1945 rate of 2.14, a 90% decrease in one year ! Automobile statistics from President's Highway Safety Conference reports published in American City magazine for August 1947, New York. p. 115. The 1946 figure of 9.8 deaths may be compared with the 1941 figure of 12.0, an improvement achieved despite 4% heavier traffic.

³ Richmond Times-Dispatch article, Sunday Nov 24, 1946: (continued next page)

and railway handle weight and bulk at low cost, the truck handles short and medium haul and less-than-carload (LCL) shipments, the automobile and helicopter will handle personalized transportation needs, the bus provides a flexible mass-transportation medium, the electrified suburban railway and subway provide cheap mass transport for metropolitan areas, in conjunction with bus feeder lines.

All of this is exceedingly important for the planner. To the extent that this trend towards a stabilized differentiation ~~bet~~ween various forms of transportation can be established, it provides a firm basis for planning transportation service requirements. Rational replanning of such abortions as the paleotechnic transportation pattern formed by Chicago's six major railroad terminals, each completely equipped with accessory facilities and yards, is possible. Provision for transportation requirements in future city environments can be made with more assurance.

Subsidiary trends such as those within the airport industry -- reduction in the required size of all but trans-oceanic airports, the elimination of noise, the increase in safety; are also of assistance in outlining planning requirements.

(continued)

WASHINGTON (science service) Aeronautics Advisory Group (NACA) seeks to reduce plane noise. Also minutes of symposium held by WHDH on Nov 25, 1946, 1815 pm EST, where representatives of the airplane industry, NACA and the US-AAF all agreed that noiseless planes were practicable except in the largest (four motored) sizes.

Good technical works are available which outline the design fundamentals for details of transportation planning, Charles Foresch and Walther Prokosch's Airport Planning fills in the last major gap in a list of standard volumes on street, railway, and waterway design of both 'traffic-ways' and traffic terminals. Two examples of available technical data for airport construction of today are included here (next pages) as an indication of design standards already available, even in this controversial field. Since airport space requirements for individual fields appear to be declining¹, the present standards are probably larger than necessary, provided a proper regional approach has been maintained towards the overall number of airports required.²

B. THE TREND TOWARDS POWER INTEGRATION

The trend towards power integration and towards lower costs of power to the consumer is also of vital interest to city planners. From the viewpoint of the city planner the important factors about power are (1) what restrictions does it place on other elements of the city plan, (2) what spacial requirements does it call for for transport, storage and use of power and fuel. The answers to these two factors are

¹ Technological Trends op. cit., p. 18. Techniques used on aircraft carriers including reversible pitch propellers and snagging devices for slowing down landings; and electric catapults for quick launchings of the largest planes have been and are being developed. See such articles as the New York Times PITTSBURG Aug 31, 1946 dispatch (published Sept 1, 1946): "Slingshot hurls plane quickly up".

² The Regional Plan Association, in conjunction with the Port of New York Authority and the CAA have prepared a plan covering 125 diversified airports for the NY region. Example.

TABLE I
RECOMMENDED AIRPORT DESIGN STANDARDS FOR COMMUNITIES, CITIES, AND METROPOLITAN AREAS

Type of Community	Planning Classification	Recommended Landing Strip Lengths, Sea Level Conditions, Clear Approaches *	Type of Aircraft Which Airport May Safely Accommodate
Small communities not on present or proposed scheduled air carrier system, and auxiliary airports in larger metropolitan areas to serve non-scheduled private flying activities.	1	1,800' to 2,700'	Small private-owner type planes. This includes roughly planes up to a gross weight of 4,000 lb, or having a wing loading (lb/sq ft) times power loading (lb/hp) not exceeding 190.
Larger communities located on present or proposed feeder line airways and those which have considerable aeronautical activity. General population range 5,000 to 25,000.	2	2,700' to 3,700'	Larger-size private-owner planes and some small-size transport planes. This represents roughly planes in the gross weight classification between 4,000 and 15,000 lb, or having a wing loading (lb/sq ft) times power loading (lb/hp) of 190 to 230.
Important cities on feeder line airway systems and many intermediate points on the main line airways. General population range 25,000 to several hundred thousand.	3	3,700' to 4,700'	Present-day transport planes. Planes in this classification are represented approximately by those between 10,000 and 50,000 lb gross weight, or by those having a wing loading (lb/sq ft) times power loading (lb/hp) of 230 and over.
Cities in this group represent the major industrial centers of the nation and important junction points or terminals on the airways system.	4 and 5	4,700' to 5,700' 5,700' and over	Largest planes in use and those planned for the immediate future. This approximately represents planes having a gross weight of 74,000 lb and over, or having a wing loading (lb/sq ft) times power loading (lb/hp) of 230 and over.

Note: Paved runways shall be 200' shorter than landing strips.

* Approaches shall be clear within a glide path of 20 to 1 from the end of the usable area for Class I airports and 30 to 1 for Classes II, III, IV, and V airports, except instrument landing runways for which the ratio shall be 40 to 1. These ratios represent the minimum permissible. In all cases it is highly desirable to clear approaches to runways *on as flat a ratio as is possible* in the interest of safety. A 50 to 1 ratio is a desirable minimum.

TABLE II
AIRPORT SIZE PLANNING STANDARDS

Recommended Minimum Standards	Class I	Class II	Class III	Class IV	Class V
Length of landing strips *	1,800' to 2,700'	2,700' to 3,700'	3,700' to 4,700'	4,700' to 5,700'	5,700' and over
Width of usable landing strips	300'	500'	500'	500'	500'
Length of runways	None	2,500' to 3,500'	3,500' to 4,500'	4,500' to 5,500'	5,500' and over
Width of runways	None	150' (night oper.) 100' (day oper. only)	200' (instrument) 150' (night oper.)	200' (instrument) 150' (night oper.)	200' (instrument) 150' (night oper.)
Number of landing strips and runways † determined by percentage of winds, including calms ‡, covered by landing strip and runway alignment	70%	75%	80%	90%	90%
Facilities	Drainage Fencing Marking Wind direction indicator Hangar Basic lighting (optional)	Include Class I facilities and lighting Hangar and shop fueling Weather information Office space Parking	Include Class II facilities and Weather Bureau Two-way radio Visual traffic control instrument Approach system (when required) Administration bldg. Taxiways and aprons	Same as Class III	Same as Class IV

* All the above landing strip and runway lengths are based on sea level conditions; for higher altitudes increases are necessary. (One surfaced runway of dimensions shown above is recommended for each landing strip for airports in Classes II, III, IV, and V.

† Landing strips and runways should be sufficient in number to permit take-offs and landings to be made within $22\frac{1}{2}^{\circ}$ of the true direction for the percentage shown above of winds 4 miles per hour and over, based on at least a 10-year Weather Bureau wind record where possible.

‡ Calms: Negligible wind conditions of 3 miles per hour and under.

becoming clearer daily. Considering them separately:

(1) The restrictions which production and use of power place on the city plan are evaporating. Cities need no longer be huddled around factories located at prime power sources. For the production and consumption of power are no longer linked, and the cost of power delivered to any given location is steadily going down.

Power production is gradually becoming a specialized manufacturing process in its own right, with various methods of transmission being utilized to furnish the desired energy product to power consumers as required. The prime sources of power -- sunlight, wind and water energy, heat exchanges from chemical and atomic reactions, and chemical energy releases such as TNT -- are all susceptible to this trend. The two new sources of power on the scientific horizon, direct production of electricity from atomic fission and conversion of solar energy to electrical or mechanical energy, will undoubtedly follow the same line. Briefly, the trend means that production of energy in usable forms will be either confined to huge central plants linked with transmission lines to consumers, or will be decentralized to small prime movers such as gasoline engines and rockets.

This specialization of power production is leading to ever-cheaper power costs. The planner must look forward to a day when industrial, commercial and residential power requirements will have literally NO effect on the location

and form of cities. Waldemar Kaempffert supports this contention:

Electric power is cheap. It has been getting cheaper and cheaper ever since Edison built his historic Pearl Street station in New York over fifty years ago. Physicists, like Dr. Van de Graaf of M.I.T., believe that out of their experiments will come a totally new way of generating and distributing energy. The late Dr. Charles P. Steinmetz even went so far as to say a quarter of a century ago that electricity would some day be so cheap that it would not pay to read meters....¹

The cheaper power gets the less effect it will have on industrial location. Kaempffert goes on to indicate some of the changes in our society which the prediction of electricity so cheap it would not pay to read meters would produce: He concludes

Man must outdo nature in the laboratory. And with the possibility of generation and distribution of energy at a cost regarded as negligible, nature would be outdone.²

Here, then, is the pattern for the future: cheap power for all purposes. The various methods of power production will be blended as required to meet the varied needs of power consumers.

(2) Turning to consider the spacial requirements of power on the city plan, the planner is faced with one new

¹ Kaempffert, op. cit., p. 35.

² Ibid., p. 37.

element: the net-work for distribution of power must be given special considerations as power use grows. The following conclusion from an excellent article on the Uses and Sources of Electric Power provides a perspective

SUMMARY: It is the function of the city planner to make sure that the plan provides broad highways for electric power; adequate space for power houses, sub-stations, and cables, and fuel pipe lines; coordination of all utility rights of way; and provision for adequate power supply for important places in emergency.¹

At present the 'ways of distribution' for power are limited to the continuous flow systems of electric transmission lines; pipelines for oil, natural gas, steam, gasoline and --- after the pending introduction of gasification of coal at the coal vein, ² -- coal gas pipelines; the old type delivery systems by large, tanker, or carload; and the potential delivery system of atomic power plant pile renewal materials by airplane or registered mail. Each of these 'ways of distribution' except the last requires extensive initial development of transport and terminal facilities. "Broad avenues of power" and "coordination of all utility rights of way" are absolute musts for future city planning.³

¹ Annals, op. cit., p. 77.

² See Kaempffert, W: Science Review feature article "We are still living in the coal age and there appears to be no escape from it". New York Times, Sunday June 2, 1946. This article presents a review of the potentialities of gasification of coal -- a process already in use in the Soviet Union. Some day coal mining as a profession will be wiped out.

³ Annals, op. cit., p. 77 gives further bibliography of value to Planners in determining what requirements should be.

One new wrinkle in power for future cities has been introduced by the atomic age. The municipal power plant may become the core of all municipal services, might in fact furnish all power used in the city. A New York Times article entitled Forecasts Cities Powered by Atom, printed in the Sunday, December 15, 1946 issue and datelined Dec 14 from Nashville Tennessee stated the following opinion of Professor Milton Burton of Notre Dame, former head of the Radiation Chemistry Section of the atomic bomb project at Oak Ridge, given in an address to the American Chemical Society:

It is reasonable to expect that within the next ten years we shall have a Federally-subsidized experiment in which a whole city may operate on atomic energy.

Such a municipal atomic energy plant, may be used in the future as the principal unit in the city's sanitation system, purifying its water supply, sterilizing its waste and producing new products at the same time that it generates power.

The details of this forecast were sketched out by Dr. Paul C. Tompkins of the Association of Oak Ridge Scientists recently.² Nuclear chain reaction produces three things in quantity: heat, radiations, and radioactive isotopes. Heat can be produced in "temperatures comparable to that of the sun"...."the chain-reacting pile will occupy the role of a glorified boiler in the field of power development"at least until some "fundamental advance in the design of the prime mover is made" (example: direct conversion to electric current). Radiations can be used: "Sewage exposed to the intense neutron,

or, preferably, gamma fields from a reactor could be sterilized" by a disintegrating process producing inert materials. Radioactive isotopes, a by-product of the proposed plant, can furnish an unfathomed number of useful materials. Taken all together this new potentiality may provide a source of inspiration for futures of cities: cheap dependable power combined with sewage disposal and profitable by-products -- all with virtually no fuel transportation after the initial installation.¹

The trend of power developments has clearly been towards integration of the procedures of power production into one universal and coordinated system. This has been proceeding under the pressure of industry for cheap and flexible power. Industrial and military research in this field is providing for the benefit of all concerned, at least so long as peace reigns.

C. FORCES REOPENING THE QUESTIONS OF INDUSTRIAL LOCATION AND SIZE

Technological progress has been laying the groundwork for an entirely new pattern of industrial size and location. A great number of trends, forming what is called a 'cluster', are combining to force an 'industrial reflow' from cities similar to the 'urban reflow' which resulted in the creation

¹ NCAI- Atomic Information Vol. 1. No. 12, op. cit., p. 9. presents Dr. Paul C. Tompkins' remarks in full.

of our present suburbs. In fact it is safe to predict that within the next generation there will emerge an entirely new pattern of industry. Some of the forces behind this trend are enumerated in the following paragraphs.

(1) The transportation developments cited above, pages 114-119, supplemented by the increasing costs of industrial transport in congested urban areas, are already promoting a movement of factories to the suburbs.

(2) The power developments cited above form a trend towards releasing industry from stringent requirements as to location and plant size because of power availability. Economical power arrangements can now be provided in a myriad different forms and places.

(3) The increasing specialization of function in industry is creating more and more plants which are neither located with respect to raw materials nor to consumers. More and more industrial processes are coming in between the growing or digging of the raw materials, and the warehousing of the finished products. Paul L. Vogt, senior social scientist for the Department of Agriculture was able to point out that even among the industries ultimately dependent on agriculture for their basic raw materials (60% of all wage earners in 1939 were primarily dependent on vegetable and animal products as a source of raw material)

only 49 out of 280 industries studied were located either in rational relation to their raw materials or to their markets.¹

This situation has two interesting aspects for planners. In the first place; more and more plants are obviously being freed from dependency on either raw materials or consumers. They can and are being located with respect to Other factors. An second, industrial location may very well be rationalized in many instances, thus effecting significant savings in transportation costs of men and materials. Both of these aspects represent arguments in favor of a trend towards industrial decentralization. When old industries are shaken from existing buildings because of obsolescence or any other factor, they tend to locate more rationally.

(4) The developing recognition within industry that the whole approach to plant depreciation and renewal must be restudied. Trends in technics are now developing so fast that unless plant equipment is replaced every 10 to 15 years, it tends to become technologically obsolete. And plants with obsolete equipment are unable to compete in the long run. Thus depreciation allowances are boosted and efficient managements strive to maintain a continuing program of equipment renewal.

¹ Peterson, Cities are Abnormal op. cit., p. 74 to 95; and Structure of the American Economy, (National Resources Committee), p. 265 ff which provides the basic data for Vogt's analysis.

This trend affects city planning in two ways. First, particularly among processing industries, technics are changing so rapidly that entire new plants and power hookups are often indicated; and firms involved are then driven to look for more advantageous plant sites. Second, new technics frequently take advantage of the 'neotechnic' processes which involve use of quiet and clean power and equipment. Many types of factories are becoming less obnoxious and may even qualify for residential area sites ! ¹

(5) The trend towards one-story acreage buildings which received impetus during the war, requires use of cheap and level land. Such buildings are inexpensive and efficient because for the usual manufacturing procedures they make the most out of flexible power hookups and assembly line techniques. Willow Run, once a bomber assembly plant and now used by Kaiser for building automobiles is only a gigantic example. In such structures a network of underground tunnels and overhead utilities provide utmost flexibility for the workspace itself.

(6) The increasing mechanization of industrial processes, the ideal being certain hydro-electric plants, chemical industries and boiling plants where human hands provide only

¹ For verification, inspect the notes of such courses as M.I.T.'s 15.70 PRODUCTION, taught by Professor Erwin H. Schell, in charge of the Department. Sections of this course dealing with plant location, industrial building design, plant layout, materials handling, processing, maintenance and salvage are an eyeopener to the city planner who looks for new ideas to help his profession.

repairs and maintenance for the automatic equipment.

As plants require fewer workers they can be located with less and less relation to centers of population.

(7) Military considerations which during the war forced dispersal of plants, are strongly in favor of decentralization of at least key industries from vulnerable city nerve-centers.

(8) National planning measures such as those currently being taken by England as part of a program to spread industrial employment regionally. Seasonal workers may then be employed the year round, and a balance of industry and agriculture may be established on a regional basis, thus reducing cross-hauling wastes of transportation.

* * * * *

Most of these forces which combine in a trend towards industrial decentralization have had little expression in past decades. Automobile assembly plants, surgical supplies plants, and some kinds of light manufacturing plants are exceptions. Perhaps the best explanation lies in the observation that pseudomorphic tendencies have existed in industrial location. Manufacturers are loath to move to untried locations, facing possibly unknown conditions. Therefore they tend to stay in their ancestral haunts long after any rational considerations would explain their action. But after a trend has been established, such as the flight

of the textile industries from the high-wage centers of New England to the raw material and cheap labor centers of the South, THEN they move rapidly. (Note that wage-differentials have NOT been cited as a force for decentraliation. Most students of the subject realize that these differentials are a temporary phenomenon, certainly not generally applicable.)

Thus the old paleotechnic pattern of more industrial plants being located near sources of industrial power and labor -- the cities, and more people flocking to the cities because only there could employment be found: this vicious circle is now in a fair way to be broken up. The day of important moves towards decentralization of our cities, in the sense of cutting down unnatural urban conglomerations to workable proportions, is approaching.

* * * * *

D. THE DECREASING RELATIVE COSTS OF CONSTRUCTION.

This is a trend supported not so much by recent prices for homes as by more basic technological considerations. The introduction of new materials, the national standardization of old materials, the development of mass-production techniques in making building materials and parts of structures, the formation of larger construction efforts; all of these trends and dozens more are merging in forming the basis for a new and more rational construction industry. ¹

¹

Willcox, Replanning Problems of New York City's Lower East Side, op. cit., pp 76 to 103.

This trend is of special significance to city planners. It points towards a new era in building construction that will create a more favorable medium for the development of entirely new city forms. However the restrictive influences of special interest groups have not yet been overcome. Such things as obsolete building codes jealously guarded by favored materials-dealers, medieval craft union alliances, fly-by-night contracting 'organizations' which only attain working size when a big job has been obtained: these types of things still have to be overcome. But the procedures are known. Utilizing continuous production methods, and aided by special research organizations yet to be created, the building industry can be developed to cut costs to a small fraction of present figures. And already, in terms of total manpower required to erect complex physical structures, the building industry is far in advance of its position of fifty years ago.

* * * * *

These four trends within technological development are presented merely to give additional meaning to the 'conceptual framework' of possibilities presented earlier by section 2. They indicate in more detail the necessity for understanding the 'grammar-school' level of understanding technological trends --- as basis for more creative planning efforts.

SECTION 6. THE 'HIGH-SCHOOL' LEVEL (Generalization of
neighborhood unit theory)

SECTION 3 above developed some basic considerations of city planning, the science of 'improving the urban environment for living'. As an example of how those basic considerations may be developed into specific objectives for a science of city planning, the following outline of a 'generalized neighborhood unit theory' is presented. To the best knowledge of the author this formulation may be termed an 'invention' in the field of city planning technique.

After developing the theory there will be an analysis of parts of three alternative generalized theories of planning which are presently occupying American planning literature. These alternative theories WILL NOT be discussed in detail. Only their salient points of agreement and disagreement will be outlined, together with a few hints as to how they may be synthesized with the 'generalized neighborhood unit theory' presented here.

* * * * *

A. THE THEORY

The concept of 'levels' in city planning design provides the

jumping-off place for a generalized application of the neighborhood unit theory for creating desirable human relationships in small communities. Lewis Mumford frequently reiterates that

The most important kind of planning is on the level of the smallest integral unit -- the neighborhood.¹

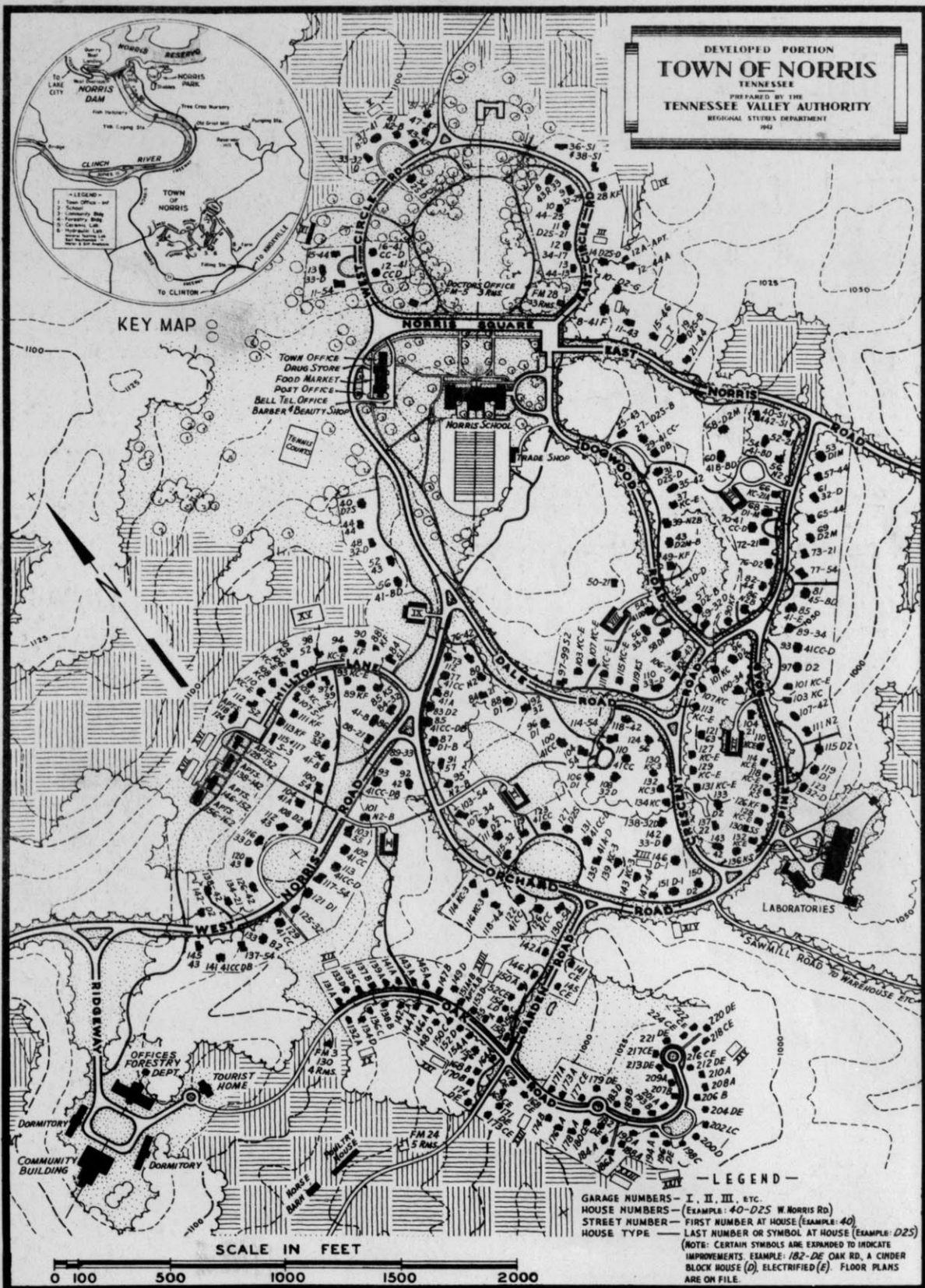
This 'neighborhood' may thus be termed the cellular unit for new city design: provided we think of that design in terms of how we can best satisfy human needs. On the following pages are three illustrations of existing American examples of it; Greenbelt, Maryland (as originally developed); Norris, Tennessee; and Fontana, Tennessee. These little communities are samples of the kind of planning on the neighborhood unit level that some day will be common throughout America.

It is of particular interest to note the non-standardized character of these plans. They retain a definite human individuality and adaptation to their surroundings which sets them apart from one another and from other towns of similar sizes.

Thomas Adams, Clarence Perry, and many others have given form and content to the theoretical concept of the neighborhood unit.² However it has not yet been fully

¹ From lecture notes on Mumford's series given at M.I.T. during the week of November 4, 1946.

² See next page.



developed nor correlated with the latest potentialities of technological trends such as those outlined as examples of the "grammar-school" level in the last section (#5)."

(1) SUB-UNITS. Lewis Mumford agrees that within the neighborhood unit there should be sub-units, each based on the "span of personal acquaintances" which a normal individual can expect to develop among his immediate neighbors.¹ The neighborhood unit is fundamentally based on the efficient size of an elementary school (see illustration next page), it might include more than 5000 people in one unit. Now 5000 neighbors is surely too large a group for a real neighborhood in the sense that an old-time village was ~~a~~neighborhood. People will just never become "neighbors" in any unit that big. Thus in terms of the 'intensive' type of human relationships previously outlined (page 85ff), a smaller unit is required -- this to be the largest unit in which all persons may be truly considered 'neighbors'. This sub-unit would be the next higher level of human relationships over the "family".

* * * * *

(2) LARGER UNITS. This concept of the sub-neighborhood

2 (continued from previous page)

For more detailed references, See Lewis Mumford's books, op cit.; also Perry, Clarence The Neighborhood Unit in Regional Survey of New York, Vol. 7. Neighborhood and Community Planning, New York, 1929. Passim. Also such articles as the Architectural Forum's Planned Neighborhoods for 194X, October 1943 issue.

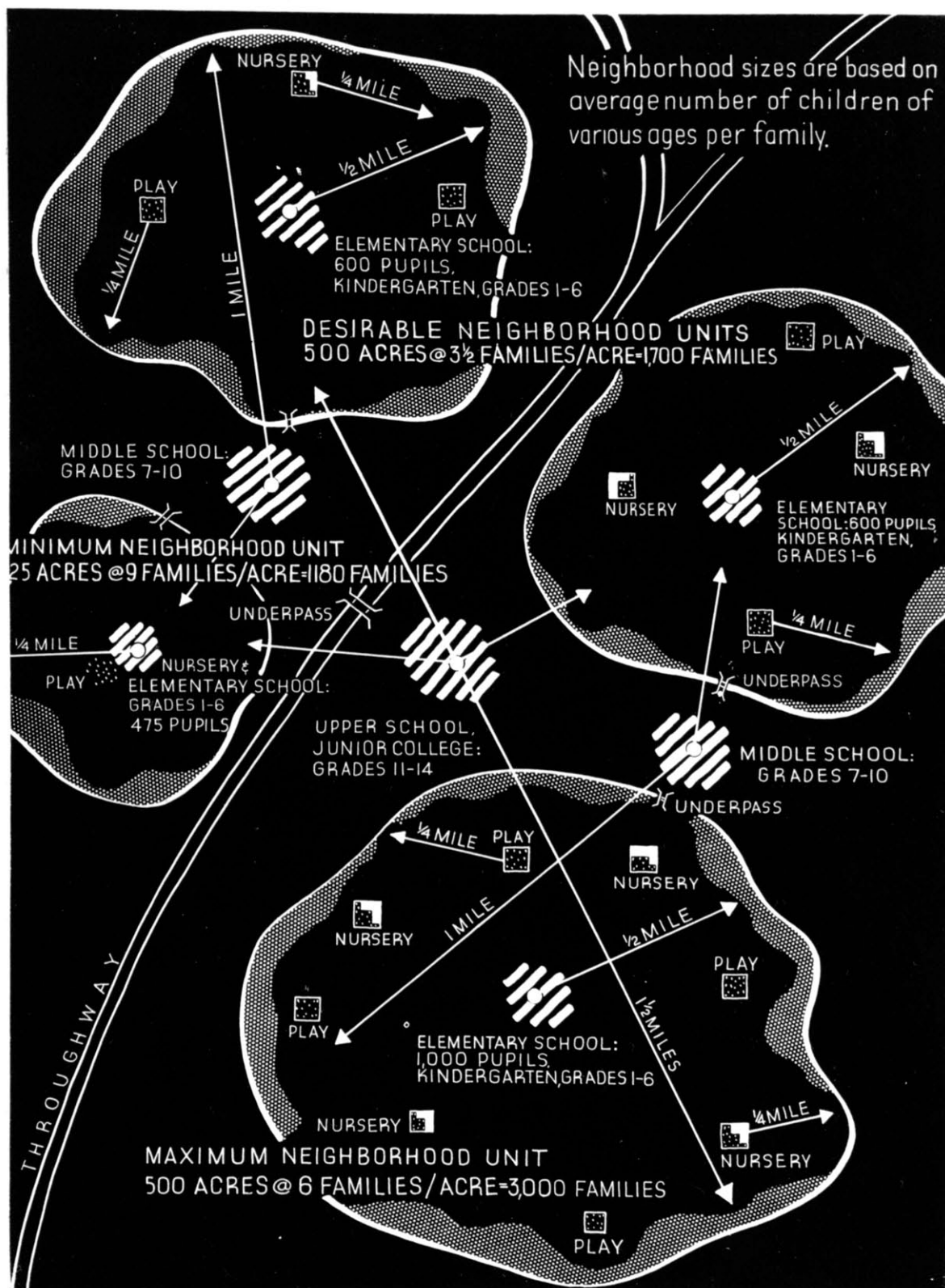
¹ This was discussed with Lewis Mumford, November 8, 1946.

unit, or 'block' expands the concept of the 'neighborhood unit' in one direction. Similar considerations as to the nature of 'extensive' human relations can be used to develop 'higher' levels of city structure, higher levels which utilize the neighborhood unit as a ~~basic~~ unit of city measurement. On the next pages are two studies of neighborhood design. The first is confined to schools and neighborhoods. The second is an attempt to demonstrate the entire range of the city planning 'levels' on one page!

Regarding this summary of all levels of planning, two points seem to need further clarification.

The first point is regarding the "20% flexibility factor" mentioned. It is the writer's opinion that perhaps 80% of the homes in any neighborhood should be permanently constructed, well designed units. This would equal the 'minimum' size for efficient community facility use by the neighborhood. Then the remaining 20% of the neighborhood would be laid out, utilities installed, and lots rented to owners of prefabricated houses or other non-permanent structures such as house-trailers. Oak Ridge, Tennessee, has a large area of this sort plus several permanent trailer campsites. ¹ There are many

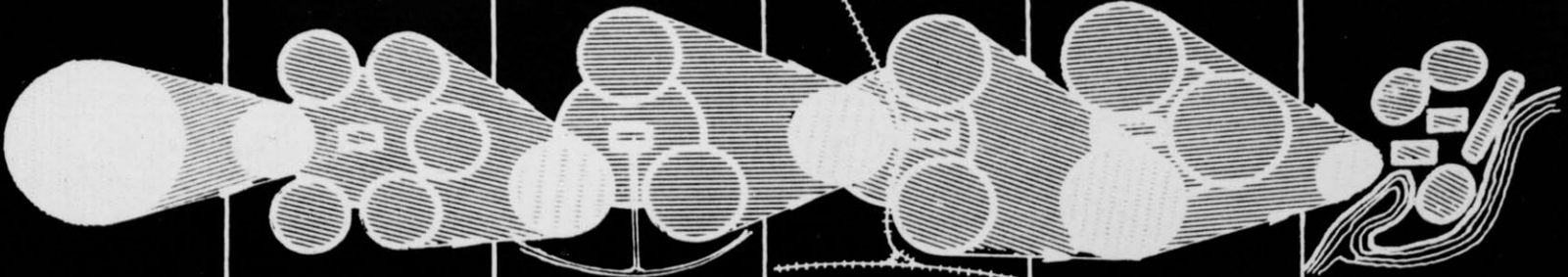
¹ However in Oak Ridge there is no coherent pattern of neighborhood units, and there IS a segregation of housing by types. Both of these trends are unfortunate from the point of view here. Other aspects of the Oak Ridge Layout are good, but some schools are unduly far from homes they serve today.



SOURCE: The Architectural FORUM, Volume 10, No. FOUR;
Planned Neighborhoods for 194X, October 1943.

"SCHOOLS AND NEIGHBORHOODS"
 N.L. Engelhardt, p.90.

DIAGRAMMATIC EXPLANATION OF "LEVELS" OF PLANNING

"LEVELS"	BLOCK, OR SUB-UNIT	NEIGHBOR- HOOD UNIT OR VILLAGE	TOWN	SATELLITE, OR GARDEN CITY	CITY	METROPOLIS
	(1)	(2)	(3)	(4)	(5)	(6)
DIAGRAMMATIC REPRESENTATION OF "LEVELS" ● = UNIT □ = ADDED FUNCTION						
MINIMUM and MAXIMUM: POPULATIONS	150 to 1000	1,500 to 5,000	5,000 to 25,000	25,000 to 75,000	75,000 to 300,000	300,000 to 2,000,000
NOS. OF NEXT SMALLER UNIT	-	5 to 10 "blocks"	3 to 6 "units"	3 to 6 "towns"	3 to 6 "garden cities"	3 to 10 "cities"
FUNCTION OF UNIT ON BASIS OF HUMAN NEEDS:	The real neighbor- hood, inti- mate contact bet- ween all members.	The larger neighbor- hood unit, "world of the elementary school child"	Smallest regular industrial unit, "world of the high-school child".	Smallest self-contain industrial unit, with agricultural belt, etc..	When required by location-- for industry, etc..	Special purpose units such as National Capitals.
TYPE OF HUMAN RELATIONSHIP:	(UNITS WHERE "INTENSIVE HUMAN RELATION- SHIPS" ARE PREDOMINANT: on basis of fact that people live closely together)					
			(UNITS WHERE "EXTENSIVE HUMAN RELATIONSHIPS" ARE PREDOMINANT: on basis of people united by their special interests through medium of communications)			
TYPICAL ELEMENTS ADDED AT EACH LEVEL:						
(a) COMMUNITY	Residences: --for old & young, --for rich & poor, --single & married. (single & terrace type homes) Day Nursery and nursing home. Playlot	Apartments (especially for people without children) Elementary school, & playground Simple group recreation (bowling, tennis etc.) Community Buildings Health Clinic Church(es) Fire Station	High-school Playfield Hospital Library, (sub) Moving picture theatre Active recre- ation (as golf, swim) Town Hall & Community Center Churches	(Junior) College Athletic field Base Hospital (specialist) Library (central) City Hall Theatre with Stage Museums	College or University Athletic Stadium Regional Library Municipal Center Convention Halls Race Tracks Amusement Parks	Major gov't. setting. Specialist and nat'l. libraries, univer- sities, cultural centers.
(b) TRANSPORT & COMMUNI- CATIONS	Off-street parking and no through streets. Helicopter landing or equivalent Bus stop.	Postal dis- trict (no. assigned) Airpark (for light and noiseless planes) Main highway connection	Post office (branch) Telephone & Telegraph Office Airport Bus terminal Main highway direct link (R.R. siding)	Post office Power sta. Railway & Bus termin- al. Regional Airport Radio Sta.	Public trans- portation network (Seaport or river port)	Major sea- port Railway terminal yards Trans- oceanic Airports
(c) BUSINESS & INDUSTRY	General Store "Home- Industries" (artists, carpenters, etc.)	Small Shop Center. Small labor- atory or other small and quiet business	Shopping Center Industrial Area Warehouse Area Town dump	Shopping District Market cntr. Power plant. Major ind. & warehouse areas.	Mass-produc- tion ind. with high size plants. Regional shop and mdse. center	Docking Facilities National Mdse Hq., Business, & Financial Offices

GENERAL NOTES:

1. ADDRESSES AND IDENTIFICATION: Each unit on each level should be individually named. The full address for a house might be --24 Melville Street, Merryland Block, Allyn Village 14, West Hartford Town, Hartford City, Connecticut. An acceptable abbreviated form would of course be: 24 Melville Street, West Hartford 14, Conn.

This address system indicates how road signs and maps would be read, for ease in finding addresses. Once a visitor had found "West Hartford 14" (Allyn Village) he or she would look for signs to Merryland Block, and then there would be only a half-dozen streets (perhaps with names in alphabetical order) to check through to find Melville Street.

2. DELIMITATION OF UNITS: Each unit on each level should be definitely limited in size (with perhaps a 20% + or - flexibility factor), surrounded and protected by a permanent belt of open land, farms, estates, forest, meadow or parkland---. Expansion of a town or city would be by creating entire new units or towns.

3. DIFFERENCE BETWEEN RURAL AND URBAN AREAS: Urban area differentiation into 'levels' is shown above. Rural areas would probably have no units larger than the "village" which would probably be no larger than the "block" shown here.

variations of this concept of flexibility in neighborhood units, but they cannot be discussed here. The idea of presenting a factor of flexibility in neighborhood unit design, so as to accomodate individual tastes and preferences as to home location and to accomodate changing needs for employment with minimum disruption to the communities, is the key.

The second point concerns the adaptability of the neighborhood unit theory as expanded, to the full span of rural, urban, and central-urban living conditions. The reader will note that THERE IS NO SCALE OF PHYSICAL SIZE OR LIMITATIONS given on the "Diagrammatic Explanation of Levels of Planning". This is a purposeful omission. It is recognized that there are undoubtedly people who now live and will always wish to live in towering apartments -- and others will wish for scattered country estates and cottages. A generalized theory cannot ignore these extremes, at least if it seeks to provide creative expression for the full range of human social relationships.

Therefore it is specifically recognized that some entire neighborhoods may be contained in one 'LeCourbusier' style skyscraper. Other neighborhoods may be built up of homes scattered over half a county; in fact each block or sub-unit may be in itself a complete rural village or and may have a small elementary school and a store or two. The greenbelt and green-wedge principles of welding homes and nature into a compact pattern must, under the expert

guiding hands of creative planners and the democratically expressed will of the people for whom they plan, must be modified in specific instances.

Thus a Manhattan of 11 square miles of residences may exist as a city of the future; with only two or three square miles of strip parks and open space around the residential areas to break up the built up area. The present declining population of Manhattan might properly be stabilized at around 500,000 families, or about 1,500,000 persons.¹ And with extensive replanning of the city's transportation and recreational networks, Manhattan might still retain most of its virtues as a vast central-urban area despite the move towards continued decentralization.

However Stuyvesant Towns of over 25,000 people in one 'project' without schools, adequate stores, playgrounds, coherent community separation or any other kind of community facilities normally found in towns of this size--- are merely another kind of slum from the viewpoint of the theory discussed here. They do not satisfy the full range of human creative needs.

(3) SUMMARY. The above two charts thus present what may be termed a generalization of the neighborhood unit theory.

¹ Manhattan's population has declined 19% from the peak census count of 2,331,542 in 1910, to 1,889,924 in 1940. Population in Lower East Side tracts has dropped two thirds from 600,000 in 1910 to 200,000 in 1940. The total number of dwelling units has declined steadily since 1930 and the 225,000 old law tenement units guarantee continuation of the trend. At this rate a population of 1,500,000 in ten years is not impossible.

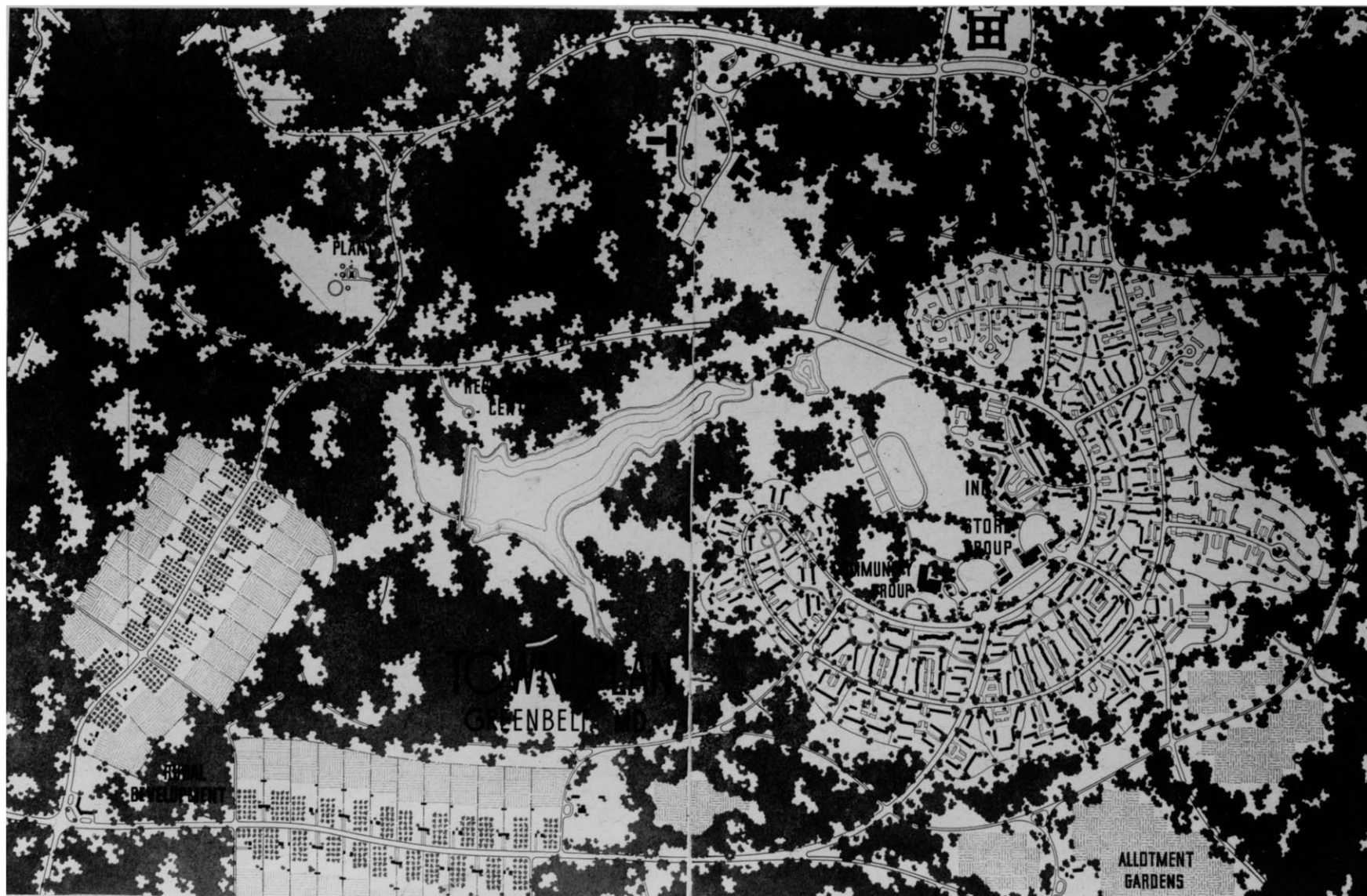
In a sense it is what British planners are working towards.¹ It presents an approach which fully satisfies the two basic philosophical principles for planning expressed in section 3, pages 75-77. Instead of a vast gridiron system, a network of steel bars confining the life and expression of our average city dweller, it provides a cellular structure based on the span of acquaintances of individual human beings. It reduces the sheer size of our cities to a coherent, human scale without eliminating the advantages of 'extensive' human relationships. It provides a framework for utilizing the unlimited possibilities of modern technology in constructive ways, breaking the old paleotechnic mold.

* * * * *

B. COMPARISON AND INTEGRATION WITH CONTEMPORARY THEORIES

A few partial comparisons with other schemes for 'new city' design may further clarify this unit theory; this example of the 'high-school' level of understanding. Among current American city planners and pseudo-city planners there are several alternative suggestions for city planning design. Three are chosen for partial analysis and integration with the suggested general theory: the schemes of Frank Lloyd

¹ See Osborn, F.J.. Green-Belt Cities, the British Contribution, Faber and Faber, Ltd., 1946.



Wright, Norman Bel Geddes, and L. Hilberseimer.

(1) FUTURAMA. Norman Bel Geddes frankly inclines to a transportation conscious 'solution'. Indeed his widely heralded FUTURAMA featured little else new. Provide better highways and better transportation, and the other ills of the community become simple to solve.--

People will see that if roads are designed specifically for their traffic, then whole cities too ought to be designed specifically for the business of cities. It is not the business of cities to serve as residential centers. It is their business to serve as occupational units, nerve-centers, headquarters. They they should be designed as such.....

People will learn that the method of dividing suburbs into square blocks fronted with tight rows of houses doesn't make them suburbs at all, but just transplanted cities. When new outlying communities are built, they will be planned long before the houses go up. Streets out of reach of and through traffic, underpasses for pedestrians, and dwellings will be set to take advantage of topography, the position of the sun, the prevailing currents of the air. *Outdoor recreation will not be provided for as an afterthought. Apply this thinking to a mill town along the Monongahela River.....A day will come when factory labor lives not in shanties on the other side of the tracks, but in healthy uplands between forest and stream¹.

Norman Bel Geddes sees the community built around its transportation. Basically his views are such that they would admit the neighborhood unit concept of planning--- because he skips right over that phase of organizing his new communities ! He goes directly from the transportation

¹ Geddes, Norman Bel. Magic Motorways, New York, Random House, 1940.



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plans to the architectural features.

Norman Bel Geddes, and also, some people infer, Commissioner Robert Moses of New York City, have incomplete understanding of the complexity of city planning problems. If by some chance cities were actually planned on this basis of transportation first and only, they would remain amorphous agglomerations of humanity. The whole world of advantages for individual human beings which is inherent in the neighborhood unit scheme is lacking. Thus while FUTURAMA is eye-catching it does not stimulate personal interests in planning; it is good advertising for a system of highways but it is not good citynplanning.

(2) BROADACRE CITY. Frank Lloyd Wright certainly had the individual man in mind: "Because the book is all for the Man of the great 'In-between' The Citizen."¹

On the level of the individual and the individual's home his grasp of the fundamentals is astoundingly complete. But in a wider sense, a thread of understanding the possibilities of social development in human beings is lacking. To Frank Lloyd Wright the "various details of the Free City..... are all primarily Architecture, from economic basis to Buildings and government."² This is because

¹ Wright, Frank Lloyd. When Democracy Builds, Chicago University of Chicago Press, 1945. p. 131.

² Ibid., p. 59.

Organic Architecture is also the essential structure of Painting, Sculpture, and Music; because it is, by Nature, fundamentally and spiritually awake to the uses and great purposes of a civilization, it must be the most vital great Art as it inevitably is the great Mother-Art ¹

From this conception L. Frank Lloyd Wright derives BROADACRE CITY:

There, each family would have an acre or more of ground to cultivate. Occasional employment would be provided in the small factories dotting the landscape. Everyone would have an auto, and the more prosperous families would have two, three, four or five autos.²

This sprawling nature of this type of home community has been praised by fellow architects such as Henry L. Kamphoefner who recognizes however, that it represents such a spread-out concept of living that much of the social values of our community would be lost. There are only endless stretches of road connecting the scattered social centers of schools, lecture halls, meeting rooms, churches, stores, with the homes.³

Kamphoefner and many others recognize that Wright overemphasizes architecture of individual homes, and therefore he inclines to such composite plans as that of L. Hilberseimer which in most respects is the most carefully thought-out plan of the three.

¹ Ibid., p. 58-59.

² Annals, op. cit., p. 150.

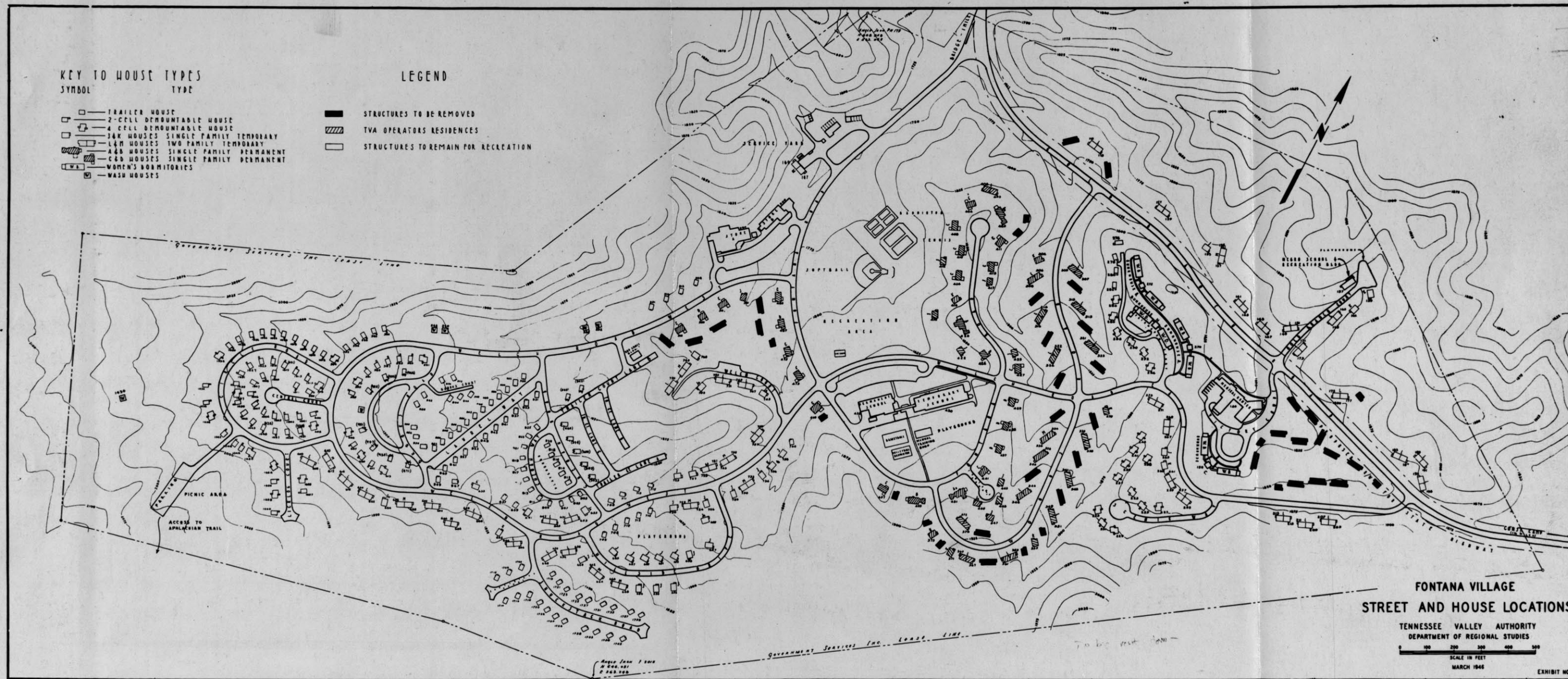
³ Ibid., p. 151. Kamphoefner's analysis is in Peterson, op.cit., p. 121f.

KEY TO HOUSE TYPES

- | SYMBOL | TYPE |
|----------|------------------------------------|
| [Symbol] | TRAILER HOUSE |
| [Symbol] | 2-CELL DEMOUNTABLE HOUSE |
| [Symbol] | 4-CELL DEMOUNTABLE HOUSE |
| [Symbol] | 1&1 HOUSES SINGLE FAMILY TEMPORARY |
| [Symbol] | 1&1 HOUSES TWO FAMILY TEMPORARY |
| [Symbol] | 1&1 HOUSES SINGLE FAMILY PERMANENT |
| [Symbol] | 1&1 HOUSES TWO FAMILY PERMANENT |
| [Symbol] | WOMEN'S BOOMITORIES |
| [Symbol] | WASH HOUSES |

LEGEND

- | | |
|----------|-------------------------------------|
| [Symbol] | STRUCTURES TO BE REMOVED |
| [Symbol] | TVA OPERATORS RESIDENCES |
| [Symbol] | STRUCTURES TO REMAIN FOR RECREATION |



(3) THE 'NEW CITY'. In The New City Hilberseimer presents a fascinating historical and a good analytical discussion of the design, development and merits of 'ribbon' versus 'centric' planning,¹ as presented by a number of different authors.

As the centric system developed from the ancient circular village which grew out of the need for defense, so also has the ribbon development grown out of an ancient fore-runner -- the one street village where houses were built on both sides of a single thoroughfare, where gardens lay behind the houses, and fields stretched beyond the gardens.²

Hilberseimer wades through the various systems and arrives at his own version of the ribbon type, whose vertebra is the transportation artery. Aside from the overwhelming preoccupation with smoke and dust nuisances that mars Hilberseimer's entire conception (as pointed out earlier the smoke menace is a paleotechnic hangover, not an unalterable scientific fact), there is a total failure to recognize the basic possibilities and necessities of the individual human being as a 'social animal'. This whole source of support for a general theory is lacking. He scarcely mentions neighborhood planning and shows absolutely no grasp of its fundamentals.

The author of this book has himself developed a planning system based on an independent settlement unit, limited in size and containing within itself all the necessary elements of a city, segregated

¹ Hilberseimer, L. The New City. Chicago, Paul Theobald, 1944, p. 59.

² Ibid., p. 66.

according to their function. In this plan, the backbone of the settlement is the main traffic artery. On one side of that artery are located the industrial areas; on the other side, first the buildings for commerce and administration set within a greenbelt, and beyond them the residential area surrounded by a park with schools, playground and community buildings in it. An agricultural belt adjoins this park.

Settlement units of this type could be combined into groups according to requirements and could be modified as necessity arose. The settlement groups would form linear or point-formed, fanlike patterns, the exact form of the group being determined by the analysis of the settlement's function and by the conditions peculiar to each situation.Each group within the city could be extended or reduced in size without disturbing the life of the city as a whole....¹ (*italics mine*)

Hilberseimer's settlement units are somewhat analagous to the larger groupings of neighborhood units, except they seem to be more flexible. But this flexibility is injurious to Hilberseimer's 'backbone' traffic arteries which must thereby accept a varying load. Furthermore they have an industrial, not a psychological basis to determine their size and location. Needs of individual human beings are ignored.

In addition to his own system, L. Hilberseimer has one exceedingly revealing comment on the 'centric' system, which leads us right back to where we started from:

The planning ideas which we have examined reveal the elements of the new city and the principles which govern the relationship of these elements. We are forced to conclude that the centric system, when it

¹ Ibid., p. 72.

exceeds the limits set by pedestrian traffic, will never solve the problems which face us today. The more the city increases in size and population, the more impossible it becomes to cope with such problems. Each new city block multiplies the difficulties at the city's center.¹

This statement closes the book on Hilberseimer ! Not only does he ignore or forget the possibilities of the neighborhood system, but he puts up arguments against the "centric" system which are equally valid against his own system. He considers Le Corbusier the prime exponent of the centric system and his argument given above is undoubtedly justified. But his absolute failure to see (a) the concept of and necessity for neighborhood planning, and (b) the possibility of building up 'cities' out of neighborhoods, towns, and satellites -- this absolute failure to make his condemnation of the 'centric' systems proposed by Raymond Unwin and Ebenezer Howard ridiculous.

It is the author's private hope that some day Hilberseimer will 'discover' the neighborhood unit theory, and the 'levels' of planning development which can be built up out of that theory. Actually, the 'ribbon' development of Hilberseimer is not too far removed from a mechanical interpretation of the cellular structure necessary for higher levels of neighborhood unit development. Eliminate the smoke obsession and substitute 'levels' of planning for the

1. Ibid., p. 74.

amorphous 'settlement units' of Hilberseimer, and a good indication of the future city might be approximated.

(4) INTEGRATION.

In summary then, these three so-called 'alternatives' are seen each to have something in common with the generalized neighborhood unit theory presented above. Each emphasizes some important aspect of the cities of the future; the highways, the architecture of the individual house, the organization of the higher levels of city structure. Elements of each are undoubtedly of value.

But ALL THREE APPROACHES fail at some point in their argument. Somewheres along the line they break that basic thread upon which civilizations are built; that weak, abused, oftentimes scorned -- but non-the-less vital element of man's social relationships with other men.

If this single element be added to each of the three alternative plans presented, and if its logical development be permitted --- the synthesis would produce something like the theory outlined ! Mix the three alternatives up and stir well with a seasoning of human needs appreciation: and a reasonably close approximation of the ideas supported here should be forthcoming !

SECTION 7. THE 'UNIVERSITY' LEVEL (Action to date in America)

The task is too great for improvisation. If the technological progress made during the years of the war is to be preserved and extended, and its benefits spread throughout the population, social legislation will have to be enacted enabling the Government to play as decisive a part in maintaining peacetime employment as it did in winning the war. If it does not, it is fantasy to discourse on the reconstruction and redesigning of our cities in terms of our new techniques.¹

This conclusion from THE CHALLENGE OF ADVANCING TECHNOLOGY, an article in the Annals issue entitled Building the Future City, November 1945, parallels conclusions reached earlier. Throughout this and all other articles of the issue runs the common refrain that immense problems stand in the way of predicting technics and improving growth of cities in America. Public support for even elementary measures which might bring relief is at a low ebb.

* * * * *

Then this is anticlimax. Because the kind of a real city planning movement we must some day have is not yet in existence. For the applications of the 'university' level of understanding; for the examples of positive planning based on policy making, fundamental and applied research, and execution; for the examples of city planning democracy

¹ Annals, op. cit., p. 52.

in action --- for all these things we must be-stir ourselves. We must MAKE them OURSELVES. There are few examples to guide us.

Some day we will be participating in an atmosphere of public planning consciousness similar to that now pervading England. When that time comes the university level of planning will have its graduate students in America too.

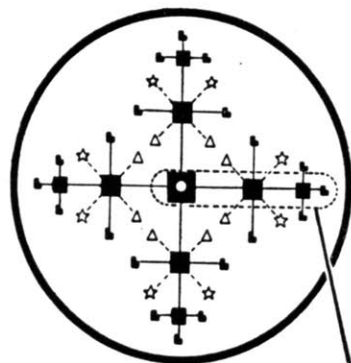
* * * * *

However two brief examples of potentialities in this field in America may be worth examining. There are indicative rather than substantive, since neither has been put into action. One is the scheme of Dr. Thomas Parran, Surgeon General of the United States Public Health Service, for a nation-wide Health Program. The other is David E. Lilienthal's scheme for an international Atomic Development Authority currently being debated by the United Nations in a somewhat altered form.

A. THE PROPOSED NATION-WIDE HEALTH PROGRAM:

Dr. Parran presents in graphic form (see next page) a plan coordinating health and sickness service, through hospitals and health centers, reaching out from the great urban centers with their base hospitals into the district and rural hospitals and ultimately to the health centers in rural communities. The chart indicates the scope and flow of service.....

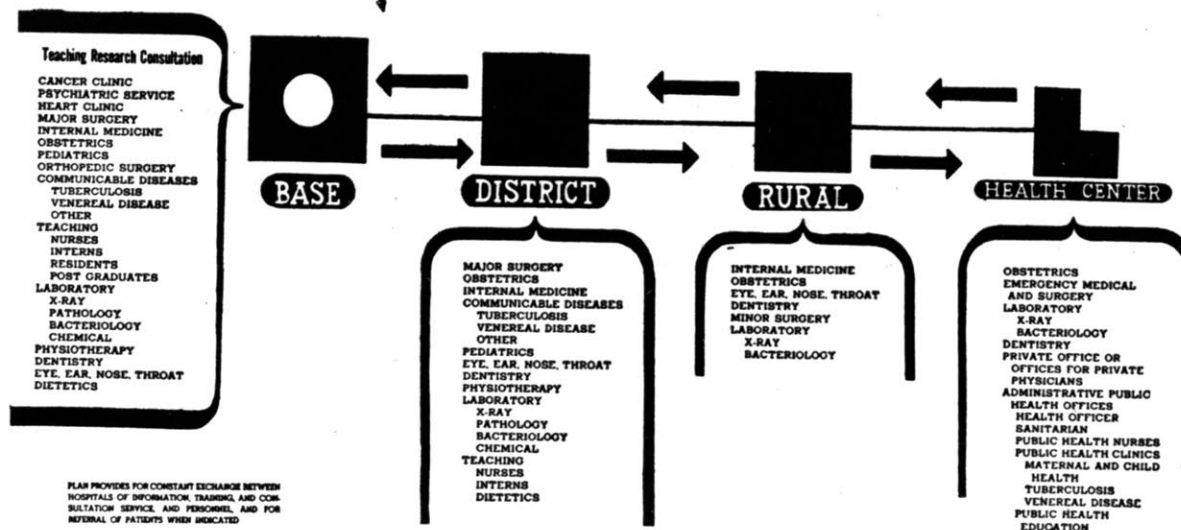
Under the proposed plans for national health insurance the traditional relationship between physician and patient is not disturbed, only financial security is relieved.....improved facilities for diagnosis and



COORDINATED HOSPITAL SERVICE PLAN

HOSPITAL
SERVICE
AREA

- HOSPITAL
- HEALTH CENTER
- ☆ INSTITUTION (CHRONIC DISEASE)
- △ NURSING HOME (CHRONIC DISEASE)



treatment are made available to physician and patient and the financial burden is equalized.¹

This example might well be cited and used for a model elsewhere. It has stimulated many further studies. Behind it are the forces of much research in medical care, and more studies are piling up all the time.

In passing on it should be noted that this chart of the Coordinated Hospital Service Plan bears close analogy to two studies of the generalized neighborhood unit design illustrating the last section (page 134). This is not accidental. The logic of successively higher levels of organization underlies all three plans !

B. THE PROPOSED ATOMIC DEVELOPMENT AUTHORITY:

The present debate in support of an international Atomic Development Authority offers a useful illustration of possibilities in the 'university' level of planning. Here the technological MEANS -- atomic power -- are fearfully evident. And the ENDS -- constructive use of that power for satisfying human wants -- are also obvious.

The proposed synthesis is the Lilienthal Report in its first form. This report proposes an Atomic Development Authority (ADA) which, through its complete control over all phases of atomic research, production and distribution, would be able to foresee future developments in the atomic

¹ Annals. op. cit., p. 145.

energy field far enough in advance to forstall any new and potentially dangerous developments. It proposed that

The plan must be one that will tend to develop the beneficial possibilities of atomic energy and encourage the growth of fundamental knowledge, stirring the constructive and imaginative impulses of men rather than merely concentrating on the defensive and negative. It should, in short, be a plan that looks to the promise of man's future well-being as well as to his security ¹

It recognized that the ADA, if it were only a police power agency limited to preventing the misuse of atomic powers, like a zoning ordinance, would fail miserably. It recognized too, that if atomic powers were left in the hands of any particular country or group of private individuals, the civilized world would face destruction.

This ideal solution bears many parallels to the proposals seconded by this essay for large-scale planning research and execution organizations. Both derive their fundamental strength from FORSEEING the future through advance research, and through guiding physical developments in accordance with the developments of that research. Both have met strenuous objections because they have become political footballs (ADA and NRPB). Both will only win public acceptance when the overwhelming support of public opinion is rallied behind them and when the political monkeyshipes have been discredited and removed.

ADA and the above proposals for planning differ in

¹ Lilienthal, David E., A Report on the International Control of Atomic Energy. Washington D.C., U.S. Govt. Printing Office, March 1946. p. 10.

one important respect. Without eventual international control of atomic energy we will have earthworms planning our cities. Without eventual establishment of a science of city planning we will have more and more chaotic cities, but the prediction that such cities will snuff out the propagation of the human race seems farfetched. This might, of course, be only a theoretical distinction. For if we cannot obtain the relatively simple organizations for scientific city planning within our own country, what hope is there that we can devise a timely international agreement on atomic energy?

SECTION 8. CONCLUSIONS

IN RETROSPECT there is little reason for any 'grand roundup' at the end of the trail. Actually what has been done is very simple. Leaving aside the numerous smaller issues, there were only two major points:

ON TECHNOLOGY: An attempt has been made to show that technological potentialities have multiplied until they are now infinite. The various trends which we can see and do draw forth from this array are merely picked from the surface. Furthermore we have invented a way of inventing. And in the long run we can direct science to practically any objectives we see fit.

ON A TECHNOLOGY OF CITY PLANNING: Therefore if we want to make the most of technology for city planning, we must enter the arena and do some directing ourselves. Not negative, laissez-faire planning; but positive, direct planning.

We must obtain a 'grammar-school' level of understanding what technology is all about. We must obtain a 'high-school' level of understanding what city planning is all about. Then

we must merge the means with the ends and produce a 'university' level of understanding: a science of applied city planning action designed to direct the course of technology.

We are a long ways from this goal. But if we fail to see it before us, we will lose our way. We need to understand what is going on -- on the higher levels as well as on the down-to-earth level of 'practical city planning'. For all we know the answers we seek may be shaped through science and technology, and through no other means alone. If that is where the answers are, we must go and get them ourselves, must work for a real technology of city planning.

Cities are what men make them
Wherever those cities may be,
Whether out on the desolate desert
Or down by the surging sea.

Cities are what men make them
What men demand they shall be,
Slothful, sloven, sleepy,
Happy, progressive, free.

(Misquoted from an
"unknown author").

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divorce rate, and a rising insanity rate.

However Peterson goes further, attempts to demonstrate that cities are also undesirable -- he seems to favor a back-to-the-land movement because he doesn't figure any other solution will help out.

His fellow specialists, each writing only on those topics with which each is familiar, are far more reliable and with two exceptions (Vogt--badly written)& (McConahey --outspoken advocate of subsistence farming and the like !) they really have something to contribute towards a better understanding of our modern city coggestion and ill-health.

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