STREET PATTERNS IN RESIDENTIAL AREAS WITH SPECIAL REFERENCE TO MONTREAL

by

Ying Hong Li

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School of Architecture,
McGill University,
Montreal.

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INTRODUCTION

The value and usefulness of any block of space depends largely on its degree of accessibility. Without the ability to enter, leave, or move within it freely, space is of no value at all, no matter how rich in resource. A modern city may be looked upon as a communications net made up of roads, paths, highways, rails and wires. Its prosperity and rate of growth are roughly in proportion to the capacity of its circulation system. Without an efficient system of circulation, a city would soon lose its function.

In a residential area, access and circulation are provided by a system of streets. On this circulation system depend the convenience and safety of the residents. Hence the pattern of streets is of vast importance to the development of a residential area.

This thesis attempts to make an analysis of the street patterns in residential areas, with special reference to Montreal Island. In Part I, a historical review of street patterns from ancient to modern is presented, with examples drawn from various parts of the world. Each example is accompanied by a brief discussion of the underlying theory. In Part II, a classification of street patterns is attempted, both by structural form and by dominating topographical features. Various systems of street

layout are described and illustrated by examples. Part III is a study of the street patterns on the Island of Montreal. It assumes a historical approach and traces the development of street patterns back to the early days of original settlement. The system of land subdivision in Montreal Island is then briefly discussed, and three types of subdivision are postulated; the unplanned penetration, the planned long lot, and the comprehensive plan for a number of lots. Based on these subdivision systems, an analysis of the development of street patterns in the past thirty years is made. The entire period is divided into three parts: up to 1932, 1932 - 1952, 1952 - 1961. The characteristics of each period are explained.

PART I HISTORICAL REVIEW

THE ANCIENT PATTERNS

Old Stone Age Settlement

"The human settlements of all ages are an expression of the societies which created them: an expression of spiritual aspirations and of material requirements. Social organization, political intention, economic means, artistic and technical ability, forms of production and consumption, means of transportation -- all these are factors which determine the form and nature of man's settlements"(1)

The modern ethnology recognized two basic types of communities -- the peasant and the nomad -- each with its own development, moulded by the environment and the activities.

To the man in the peasant community, the plants, his means of livelihood, were the determining elements of his culture. The life process of plants suggested to him a synopsis of all life, symbolized to him the close connection of all things. He drew no distinction between matter and spirit, for to him all things were animate(2). His settlements were rooted in the soil like trees. To the man in the nomad community, the animals were the determining elements. The life process of those animals suggested to him a synopsis of all life which endowed their existence

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(1) L. Hilberseimer, The Nature of Cities, Chicago: Paul Theobald & Co. 1955, p. 15.

(2) L. Hilberseimer, The New City, Chicago: Paul Theobald & Co., 1944, p. 19.

with significance and purpose. He perceived only reality and was opposed to all that was irrational[3]. His settlements were tent settlements, moving from time to time according to natural necessities. This coexistence of peasants and nomads reflected the contrast between two types of structural form: the 'organic' and the 'geometric' both representing particular communal structures.

The pre-historic settlement of Glastonbury (Fig.1) and Castellazzo de Fontanellato (Fig.2) were evidence of the early existence of these contrasting types. Both were original forms and expressed differing concepts of life and society in their purest form.

Castellazzo was probably a "geometric" form of settlement of the first Latins who entered Italy from the north. Its pattern expressed a well-established social order. The city was surrounded by a deep, wide ditch which made the site a kind of an island. Its street system was laid out geometrically; the center street was wider than the others and east of it was a square. Glastonbury in southwest England, in contrast to Castellazzo, showed all the characteristics of an "organic" settlement. For protection, it was placed on an artificial island in a lake. Its huts, circular in shape, were isolated or combined in groups. In the centre of the settlement there was an open space.

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(3) Ibid., p.19.

Though these types of settlements are seldom presented in pure form nowadays because of the fact that the completed structure is not always analogous with the idea which created it, and because of social, political and population influences which cause further deviations, the tendency to organic or geometric form can always be recognized: geometrical settlements are typical forms of autocratic communities; organic settlements are peculiar to free communities. We find these types all through the ages.

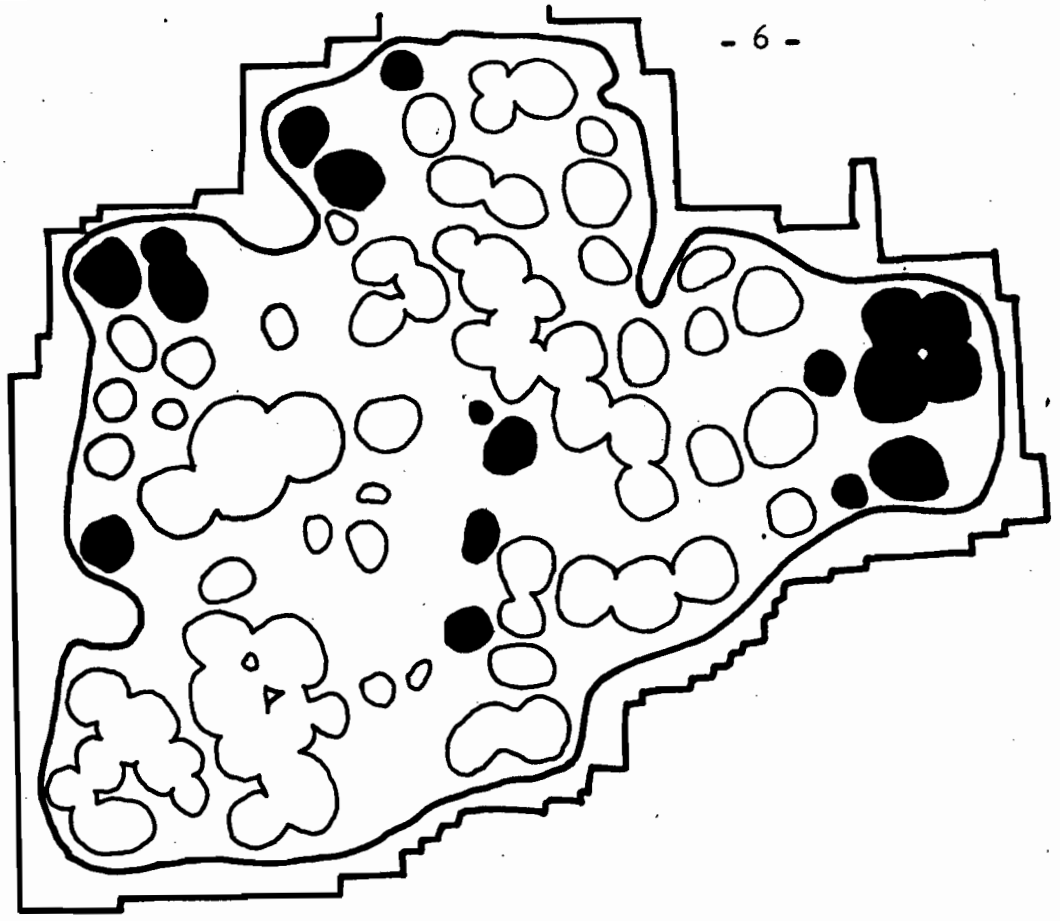


Fig. I Stone Age settlement at Glastonbury

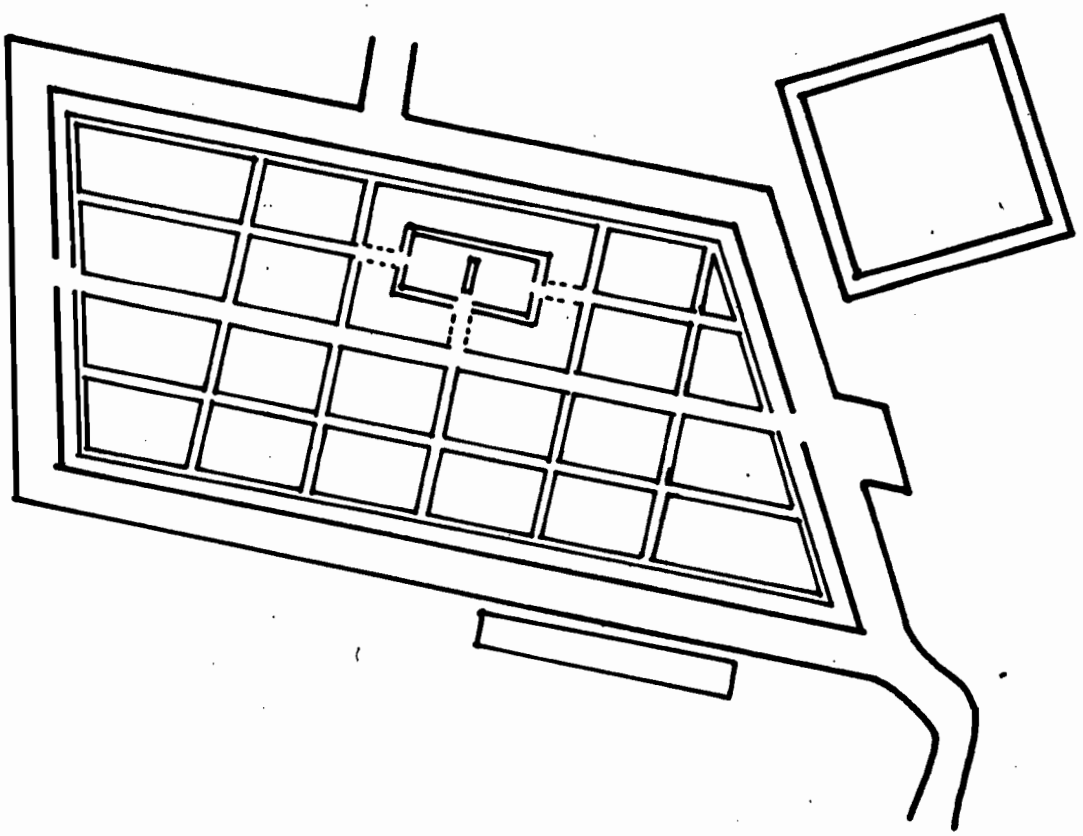


Fig. 2 Stone Age settlement at Castellazzo de Fontanellato

Egypt and Mesopotamia

In ancient Egypt, the lives of the people were dedicated to the Pharaoh. The towns were erected upon his order. They housed the slaves and artisans engaged in building the great pyramids. The town of Kahun (Fig.3) was built to house the workers building the pyramid for Usertesin II around 2650 B.C. It was situated a fair distance from any other urban community and it might be presumed that the duration of its active life was decided by the period taken to build the pyramid. Despite its obviously limited life, the town was carefully laid out. It was hardly more than an assembly of cells arranged in rectangular blocks to which narrow alleys gave access. The apparent difference in the size of these cells indicated a distinction in class among the inhabitants. Kahun implied that the Egyptians planned town or tended to do so with parallel, elongated streets. This was borne out, a thousand years after Kahun, in the model village of Tel-el-Amarna, (Fig.4), provided for workmen employed in building the royal city and tombs of Akhensten. Tel-el-Amarna was built a few miles east of the palace-city, like Kahun, it displayed an astonishing functional effectiveness in its compact, methodical planning. According to Sir Leonard Wooley who directed the excavations, this village was described as:

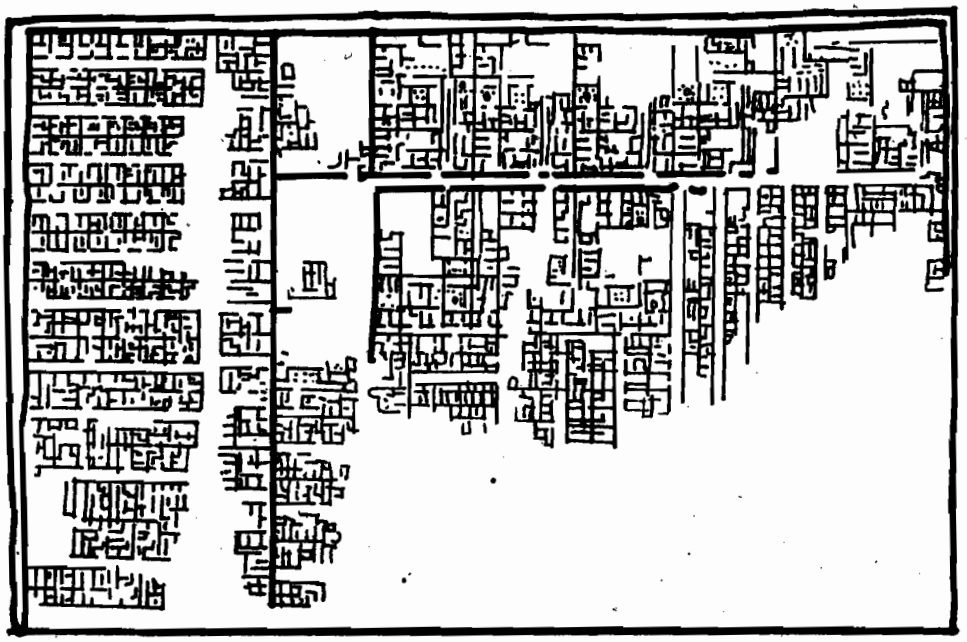
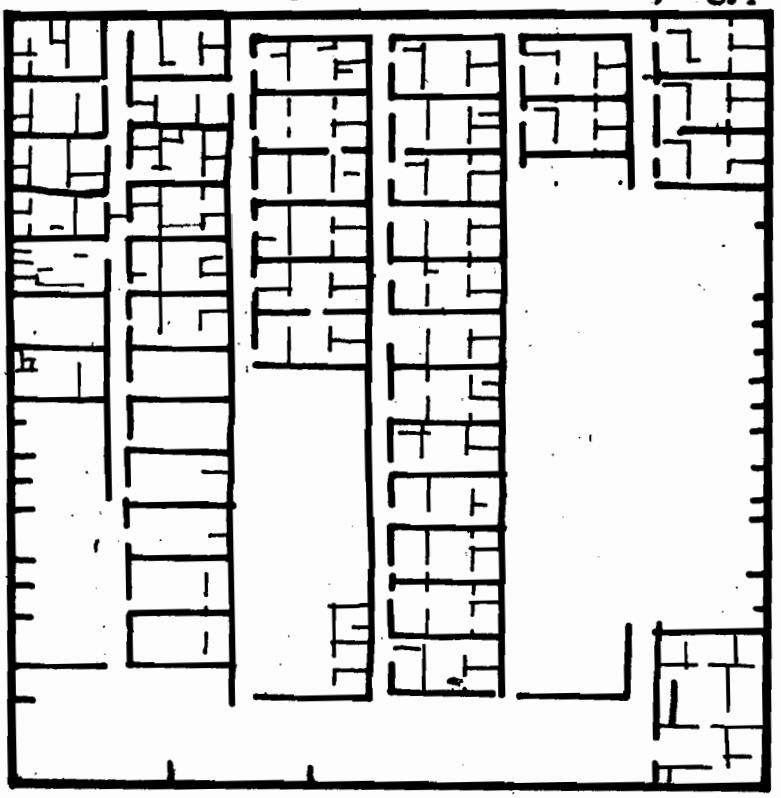


Fig. 3 Kahun, Egypt.

Fig. 4 Tel-el-Amarna, Egypt.



'a square-wall enclosure entirely filled with rows of small houses, divided by narrow streets;.....showing town planning in its most perfect form, with uniformity as a guiding principle'(1)

Although both Kahun and Tel-el-Amarna were enclosed by a wall, neither of them appeared to be fortress towns. Because the kingdom was broad and mighty, the walls were probably built primarily for protection from seasonal floods rather than the armies of invading enemies.

Two other towns dating from about the same time, Erbil in north east Mesopotamia built around 3,000 B.C. and Sinjerli in Syria built around 1500 B.C., were interesting examples of Ancient cities. They were roughly circular in shape with a fortification wall and an internal citadel at the high point. They appeared to be precursors of the medieval hill town. The street layout of these towns lacked the carefully laid out rectangular system of Kahun and Tel-el-Amarna. It was probable that these considerations were neglected owing to the exegencies of defensive building, hence the emphasis on building a town on a mound or high place encircled by a wall of the small perimeter.

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(1) F.R. Hiorns, Town Buildings in History, London: George G. Harrap & Co., 1956. p. 14.

Greece

The Greek culture was considered to be the culmination of the cultural development of Antiquity. Their city was a clear classification of functions: God, community and private life. Monumentality was first for the king, then for the Gods; the agora was a community place, simply arranged. Then there was the place for private life which was very humble.

The plans of the older Greek towns were irregular. But later they began laying out their cities in squares. In the fifth century B.C., an architect from Miletus, by the name of Hippodamos had been credited with the origination of the 'grid-iron' system, although this was not entirely accurate. A semblance of geometrical form had been present in early towns of Egypt where a formal rectangular pattern was used. The grid-iron pattern was applied by Hippodamos to obtain a rational arrangement of buildings and circulation. However, it was believed that the regular city plan was a practical measure which developed by itself and that Hippodamos' contribution was to form a theory from it and put it into practice. The city plan was conceived as a design to serve all the people. The individual dwelling was the common denominator. Blocks were shaped to provide appropriate orientation of the dwellings with them. The functional uses of buildings and public spaces were recognized

in the arrangement of streets. They served to facilitate the circulation of people and vehicles without interference with the orientation of dwellings or the assembly of people in the market place.

Superimposing the rigid geometrical form of the Hippodamian street system upon the rugged topography of the sites occupied by most Greek cities created numerous streets. These were so steep, they could be negotiated only with steps, an arrangement possible in the days when street traffic was very small. The city of Priene (Fig.5) and Miletus (Fig.6) demonstrated the Hippodamian plan as it developed toward the end of the Hellenic period. The agora occupied the approximate geographical centre of the town. About it were the temple shrines, public buildings, and shops. The dwelling blocks were rectangular and were planned to provide the appropriate orientation of houses. The contours of the site indicated that some of the streets were very steep, steps being frequently required, but the main streets connecting the gates and the agora were generally placed so that beasts of burden and carts could traverse them readily. The interesting thing in this gridiron plan was that the plots were laid out first and then the wall was built taking into account the topography of the land. In this way it differed from the Roman plans where the walls were built and then the streets fitted in.

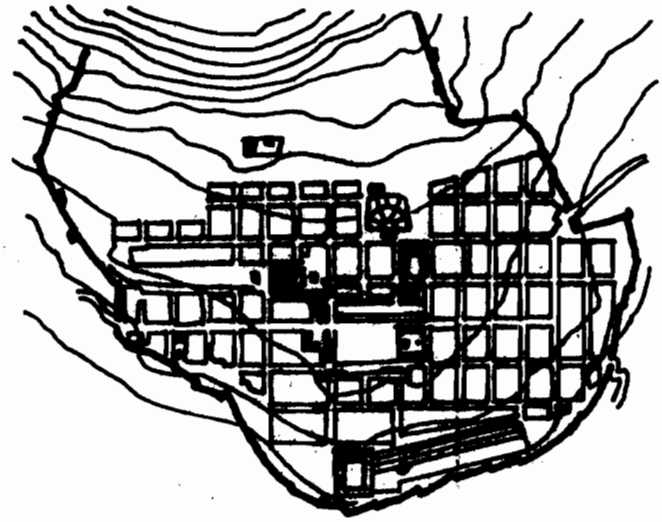
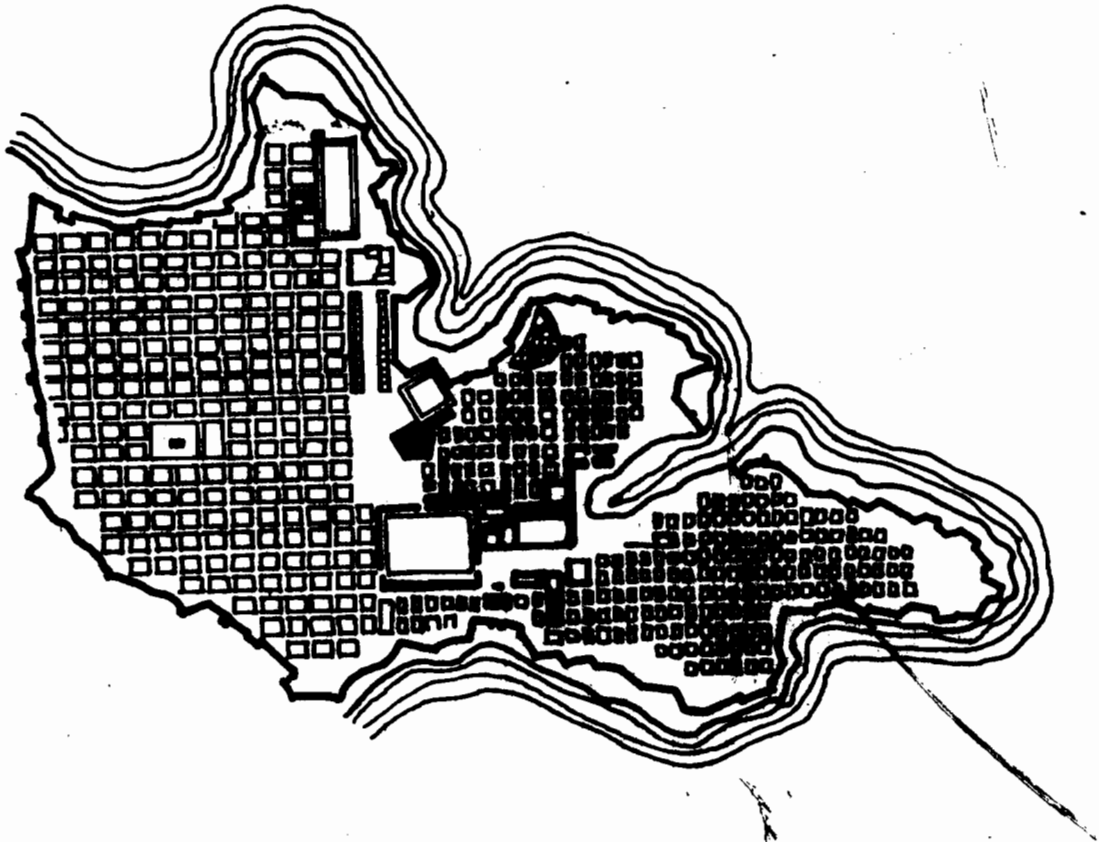


Fig. 5 Priene, Greece

Fig. 6 Miletus, Greece



Rome

The foundation stones of the Roman town were quarried mainly from two other cultures, the Etruscan and the Hellenic. From the Etruscans, came the religious and superstitious parts of Roman urban development. The Romans carried out Etruscan rites in founding new cities(1): not merely did they begin with an augury, to make sure of the favor of the gods, but the tracing of the outlines of the city was done by a priest, who guided the plow. From the Hellenistic town the Roman received a pattern of esthetic order that rested on a practical base, and to each of the great institutions of Milesian planning -- the formally enclosed agora, with its continuous structures, the broad unbroken street lined with buildings, and the theatre -- the Roman gave a characteristic turn of his own, outdoing the original in ornateness and magnificence.(2)

The Roman city began with a wall; and the city, for religious and utilitarian reasons, took the form of a rectangle, setting the standard pattern for the overnight camp which the Roman legionary later dug for himself. The border of the city was called the POMERIUMI, a sacred belt inside and outside the wall where no buildings might be placed. The military advantage of this practice for the defenders of the city may have added

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(1) Lewis Mumford, The City in History, New York: Harcourt Brace & World, Inc., 1961, p. 206.

(2) Ibid., p. 207.

extra force to the religious sanction. In addition to its sacred outline, the Roman city was oriented to harmonize with cosmic order. The typical mark that distinguished it from Hellenistic cities of the same general character was the layout of its two principal streets: the cardo, running north and south, and the decumannus, running east and west. By the time of Vitruvius, a regard for hygiene and comfort further modified the layout of the Roman town, as he suggested that minor streets or alleys be oriented to shut out the unpleasant cold winds and the 'infectious' hot ones(3).

In general, the Roman town was usually a rectangle broken up into four more or less equal and rectangular parts by two Principal streets which crossed at right angles at, or near, its centre. To these two streets all the other streets ran parallel or at right angles, and there resulted a definite 'chess-board' pattern of rectangular house-block, square or oblong in shape, more or less uniform in size. The streets themselves were moderate in width; the main thoroughfares were a little wider than the rest, and the public buildings within the walls became merged in the general mass of houses. The chief structure, of the forum, was an enclosed court, decorated by statues and girt with colonnades, but was devoid of facades which could dominate a town. Timgad (Fig.7) in North Africa and Silchester (Fig.8) in Britain were typical examples of the Roman city.

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(3) Lewis Mumford, The City in History, New York: Harcourt Brace & World, Inc., 1961, p. 207.

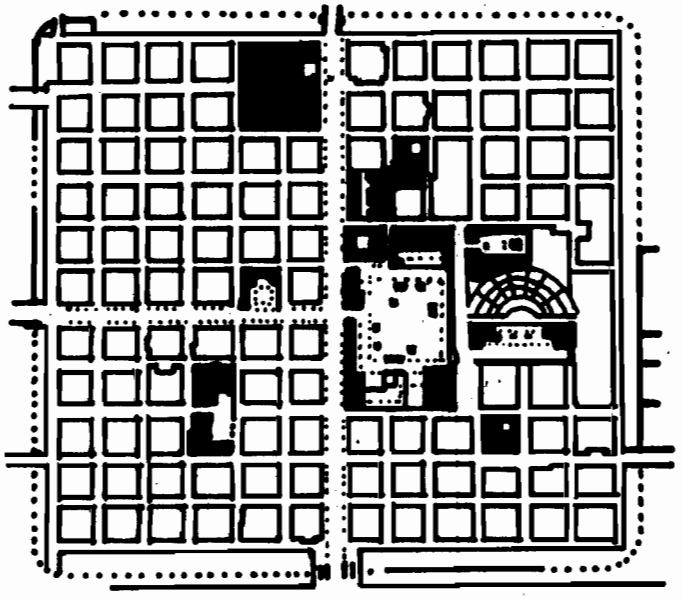

Fig. 7 Timgad, North Africa

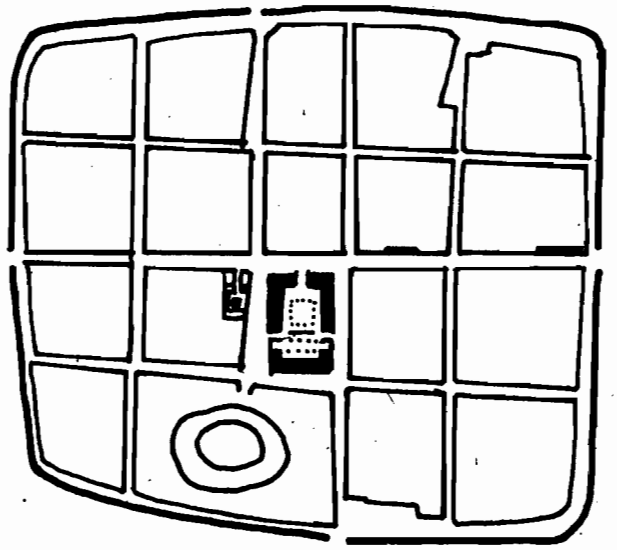

Fig. 8 Silchester, Britain

MEDIEVAL STREET PATTERN

In the medieval days, the means of travel being by foot, the streets were laid out in an informal and intimate manner into such system of roads as to fit primarily for pedestrian purposes. These roads had varying widths and shapes so as to make the slow movement of masses easy and natural. At certain important corners, these roads were broadened in order to introduce more openness in the street panorama and to allow occasional gatherings of people without disturbing traffic. About the City Hall, the Cathedral and other public buildings, still broader areas were left open, and these were formed into squares and plazas of informal, yet impressive character. As such, they constituted the nuclei of the town where public meetings and ceremonies were held. Functionally, they had to serve the same purpose as the Roman Forum of the ancient times.

The town was surrounded by protective walls where towers and similar features at certain intervals constituted the central points of protection. In order to enhance protection, the town sites were usually situated on irregular terrains, occupying hilltops or islands. The circulation and building spaces were moulded according to these irregular features, and naturally assumed an informal character. The roads radiated generally from the church plaza and market square to the gates, with secondary

lateral roadways connecting them. The irregular pattern was probably consciously devised as a means to confuse the enemy in the event that he should gain entrance to the town. Since hand to hand fighting was the method of warfare in those days, the confusing labyrinth of streets was most appropriate. The discovery of gun powder changed much in this respect and, particularly when artillery was introduced into the battle, the change was rather radical. For example, Napoleon III quickly became aware of this fact, for he had much trouble with the frequent uprisings in Paris(1). In the medieval street system of that city his cannons were of little effect, and for this reason he had to cut straight streets in the urban body, producing in this manner a new type of protective street pattern for those means of warfare that he had at hand.

We would find two phrases in the development of medieval towns. Firstly, there were those towns which had their origins in small settlements under the protection of fortified castles. The slow growth of these settlements happened to the castles in much the same manner as the stem of the tree growing thicker by producing its yearly rings. The respective plan patterns characterized this kind of gradual growth by circularly curved streets. To illustrate this ring-formed development, we might mention as typical examples, the Noerdlingen in Germany (Fig.9)

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(1) Eliel Saarinen, The City, New York: Reinhold Publishing Corporation, 1943, p.43.

the Carcassone City in France (Fig.10), and the Udine in Italy (Fig.11). Secondly, we would find those towns which constituted strategic points as military, commercial, and communicative centres and therefore, they were expected to grow to a considerable degree. This kind of town development took place on later date, and its plan pattern showed a certain leaning toward regularity. We might, from the rich material of examples, mention at random Rostock, Aigues-Mortes, and Verona, respectively in Germany, France, and Italy. (Fig. 12, 13, 14)

Fig.9 Noerdlingen, Germany.

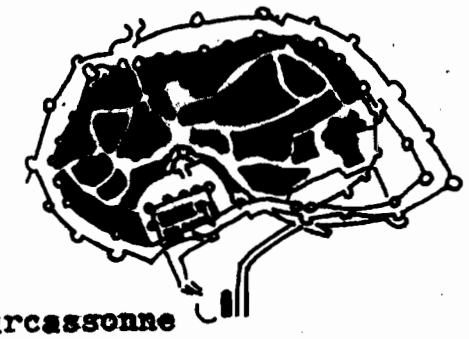

Fig. 10 Carcassonne
Cité, France.

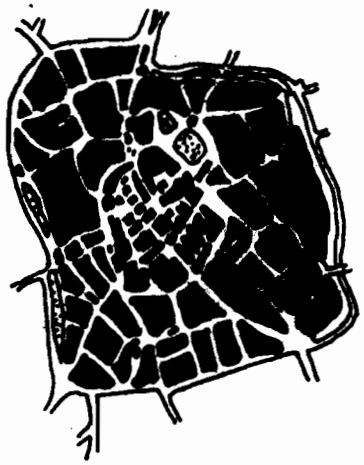

Fig.11 Udine, Italy

Fig. 12 Rostock, Germany.

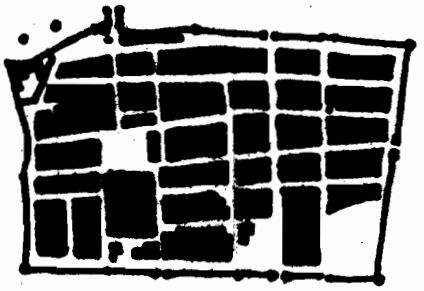

Fig. 13 Aigues-Mortes, France.

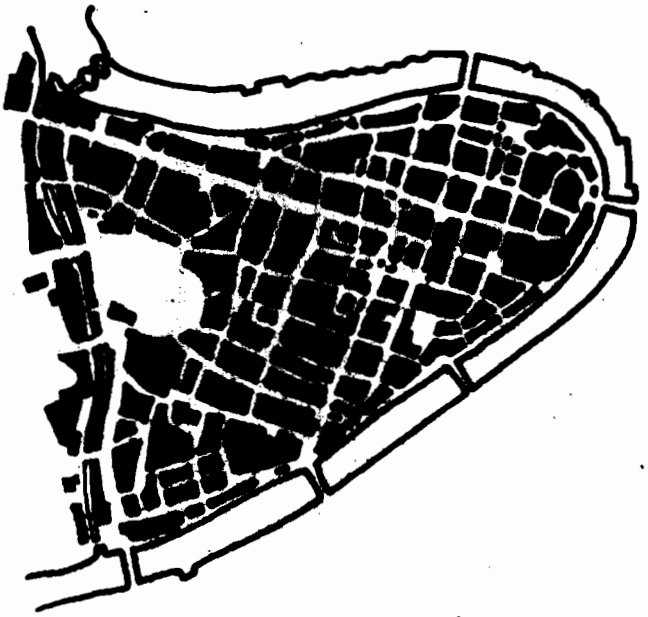

Fig. 14 Verona, Italy.

THE RENAISSANCE AND BAROQUE

The new weapons which followed the invention of gun powder created problems unknown to the colonial towns of the Middle Ages. Before the advent of gun powder and the cannon-ball, cities could be protected by palisades or walls. But these were no longer sufficient. Earthworks became necessary. Attackers must be met with flanking fire. The castle acquired projecting towers and the ramparts were fitted with bastions. The Renaissance was dominated by one city type which, for a century and a half, was impressed upon all schemes; these cities had their outward form logically determined by the laws of defence against the firearms of the day: this was the star-shaped city. From a symmetrical fortified polygon, radial streets led to a main centre. (This was the basic diagram.) The central area was left open, or it contained a central tower, from which the radiating streets were seen in shortened perspective. Palma Nove (Fig.15) was a perfect sample of fortification motif. It was built as a fortified place for the defense of Venice. It was a nine-sided polygon in outline, with a hexagonal square at its centre. A tower was placed on this square. From the middle of each side of the hexagon, a main street led to the gates or to the bastions. Connecting streets parallel to the sides of the outer polygon were intersected by other radial streets. Some of the streets crossed

smaller squares at some distance from the main square. The central building in the middle of a star-shaped city fulfilled the role of a symbolic observer standing at the focal point. Thus in the Renaissance Period every form had its centre line, and every space its axis. The structural quality of the Middle Ages was replaced by a classical sculptural form modelled symmetrically[1]. The axis and the strong centre line symbolized the growing concentration of power. Cities were opening up, and the city of the Middle Ages was being released from its clutter. The transition from the Renaissance Period to the Baroque Period was in process.

During the Baroque Period, Louis XIV ordered the removal of his palace from the congested city of Paris to the open hunting grounds of Versailles, and he ordered the avenues to radiate from his magnificent palace. The most impressive feature of Versailles (Fig.16) was the three radial streets which traversed the city and led to the large square in front of the palace. These streets approached the palace and had it always in view. Their arrangement in relation to the square and the palace realized both dominant tendencies of the Baroque: its dynamic movement and its trand for pomp and display[2]. This arrangement became a feature of Continental towns. At Karlsruhe, Germany (Fig.17), the number of streets was increased to nine, all of them oriented toward the

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(1) Arthur B. Gallion, The Urban Pattern, New York: Van Nostrand Company, Inc., 1950, p. 45.

(2) L. Hilberseimer, The Nature of Cities, Chicago: Paul Theobald & Co., 1955, p. 180.

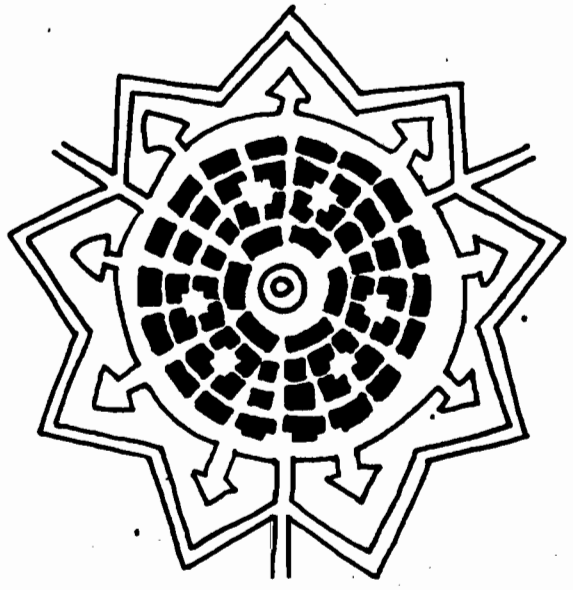

Fig. 15 City of Palma Nova

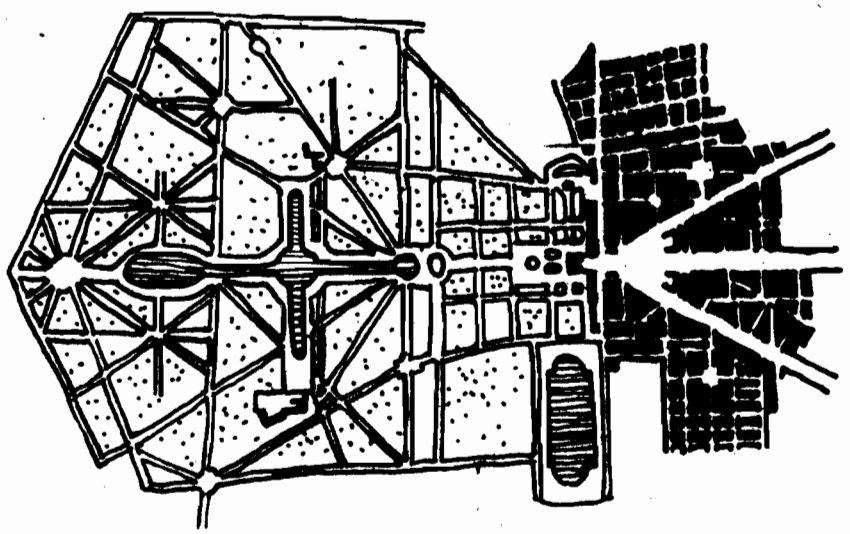

Fig. 16 Versailles, France.

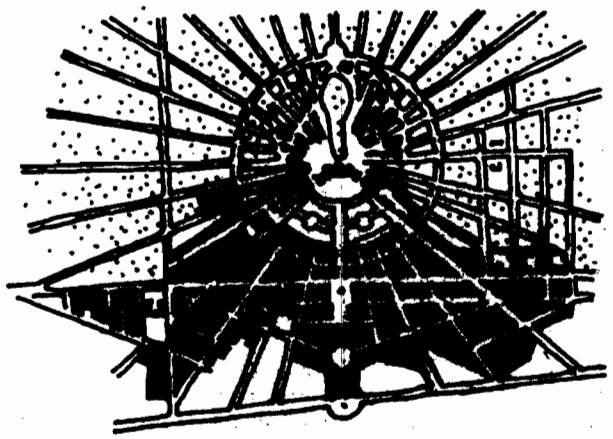

Fig. 17 Karlsruhe, Germany.

tower of the palace; each of the nine streets had an important view, together they symbolized the omnipotence of the prince.

Another feature of the layout of the Baroque cities was the chess-board or girdiron pattern. In North America it has been not only the foundation of design, but has formed the method of cellular growth. William Penn's plan for Philadelphia (Fig.18) had the greatest progency of any theoretic scheme(3). Taken by itself it was practically the Roman plan with a square at the intersection of two main roads, the square was meant to be left open but was filled in by the great City Hall. A square block park was placed in each of the four quadrants. The early dwellings were single-family houses. In the middle of the eighteenth century it became common practice to build dwellings on the side lot lines resulting in continuous rows of buildings which cut off access to the rear yards. Alleys were then cut through the centre of the blocks. These alleys have since become streets. The Savannah plan of 1773 was a regular pattern of rectangular streets with park squares liberally spotted in alternate blocks (Fig.19). The plan was similar to Philadelphia with a more generous allocation of open space.

The Renaissance modes shaded off into Baroque. While the Renaissance perspective was based on strictly limited range of

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(3) Abercrombie, Patrick, Town and Country Planning, London: Thornton Butterworth Ltd., 1933, p. 73.

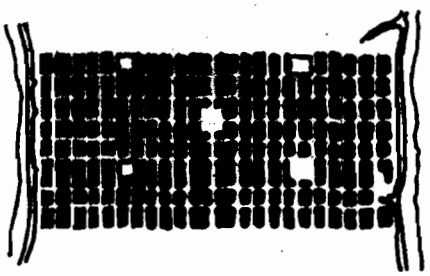

Fig. 18 Philadelphia 1682

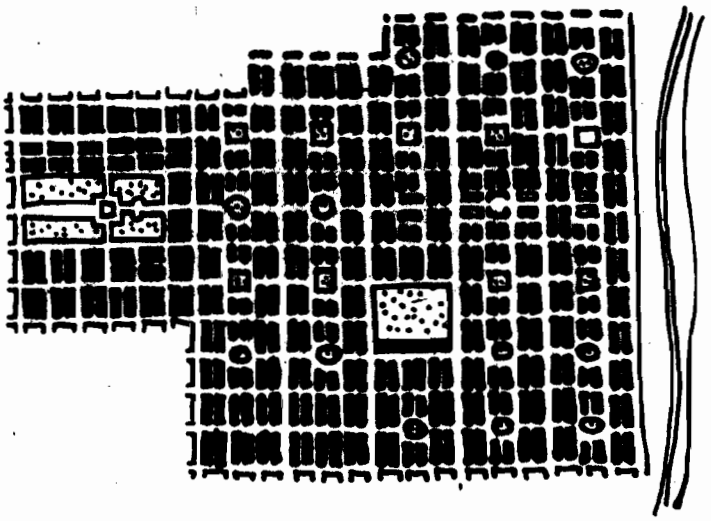

Fig. 19 Savannah 1733

distance, the Baroque perspective was based on limitless field of vision. "Baroque" indicated more of a period than of special shapes; its outstanding feature was the development of a specific kind of universality.

THE INDUSTRIAL AGE

The abrupt increase in production brought about in the eighteenth century by the introduction of the factory system and the machine, the Industrial Revolution, changed the whole appearance of the world. The population began to shift from the country to the city; numerous new urban settlements arose and old towns gained in size and population. Simultaneously, more and more people changed from farming to urban occupations and the population was growing at a hitherto inconceivable rate. The result was overcrowding in squalid hastily erected housing. The towns soon started to grow and to spread their webs over previously untouched woodland.

The new industrial economy brought exploitation of the poor and, with poverty, came the slums. Row upon row of crowded workers' houses were erected in the shadow of the factory. During this period of growth, a number of idealists and public-minded citizens realized that this situation could not be allowed to continue, and a number of utopian communities were proposed. Some of these were unrealistic, and the genesis was suggested not by the visual shape of the city, but by a dissatisfaction with the conditions prevailing at that time. Most of these schemes had proved valuable despite their unrelated forms. One such schemes was that of Robert Owen who developed New Lanark, England.

Owen, an English industrialist moved by the problem of ill-housed industrial workers and increasing unemployment, proposed a plan for a community which he believed could become self-supporting and could reduce the heavy cost of public relief. Between 1800 and 1828, he carried out work at New Lanark and amongst other tasks he developed a commercially successful industrial village. He attempted to apply his principles throughout the land, the idea being known as ' a village of cooperation '. In the plan (Fig.20) the village was square with symmetrical street blocks. The size of the population was to be 1200 with 1200 acres of arable land. Dwellings were grouped about a large open space in which he located the communal buildings. Surrounding the dwellings were large gardens, and this entire area was encircled by a main roadway. On one side of the compound were the factories and the workshops.

In 1849, James Silk Buckingham put forward a solution very similar to that of Owen. He suggested a city of 10,000 people. He hoped that his first city called Victoria would be a model town. Victoria, which was to be built in the open country, was to be composed of numerous buildings, larger ones in the centre, progressively smaller ones toward the outskirts, arranged in parallel rows on a rectangular plan. The layout plan (Fig.21) consisted of an outer ring of worker's homes, next is a ring of

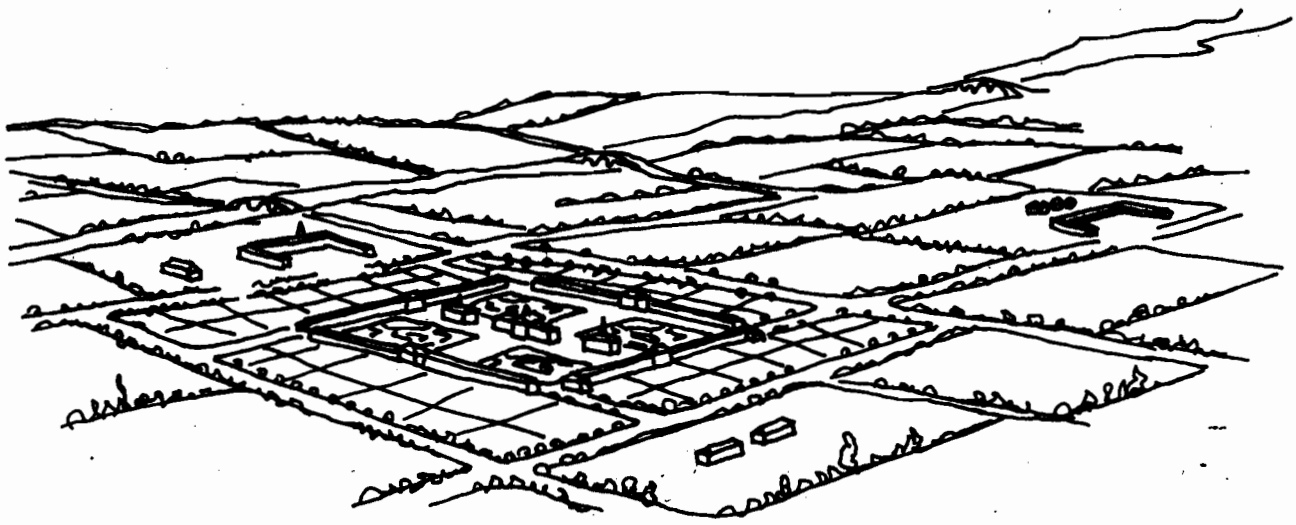

Fig. 20 Robert Owen's Scheme for a Model Town

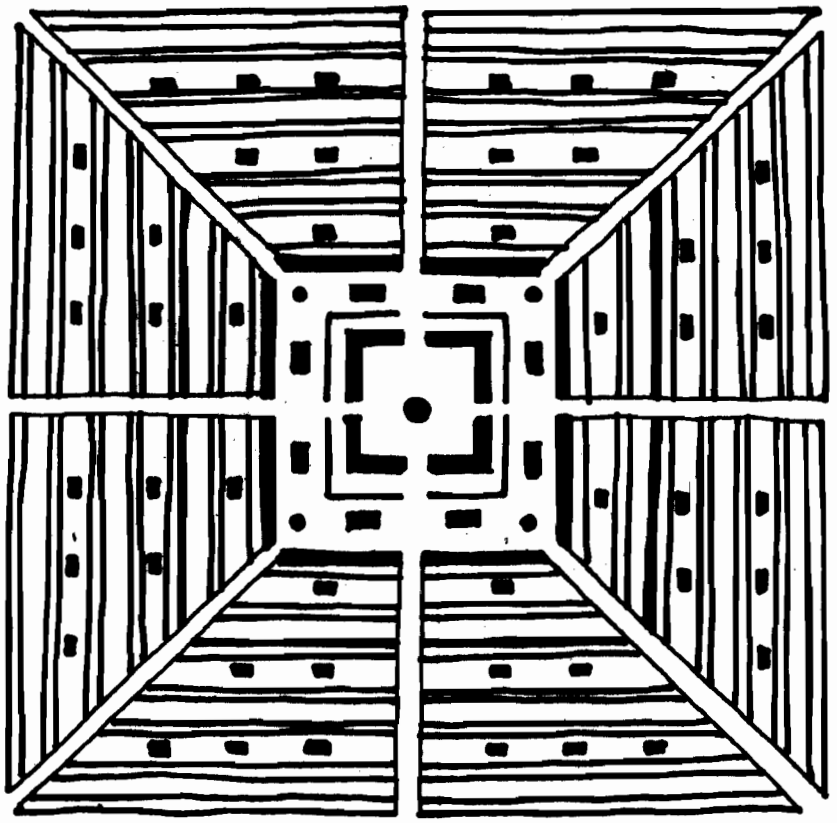

Fig. 21 J. S. Buckingham - plan for Victoria

of workshops (light industry), the third ring was for white collar housing, and the next a shopping and commercial square, the higher class housing and a park. Cemetaries, abattoirs, markets and factories were to be on the outside of the city. The land was divided into triangles each containing the same number of private and public buildings, hence anticipating the idea of orderly development. Residential areas were placed near the city centre. All these points were sound in principle, the most valuable ideas, however, were the provision of pedestrian walks and green parkland within the city, and the foresight to examine the problem on a national scale. The ideas of Buckingham influenced reformers for some twenty years thereafter.

In 1852, Sir Titus Salt built Saltaire (Fig.22) for some 3,000 workers in his textile mill near Bradford, England. Extensive community facilities were introduced into this development. The streets were laid out in gridiron pattern. On examining the plan in detail, it becomes apparent that the layout has all the features of a slum. As yet, no concept of open housing with green land penetrating the residential area had emerged. The town was largely dependent upon the philanthropy of the developer. There was no open space within the town, although allotments and open spaces on the far side of the river were provided. It is interesting to note that a definite attempt

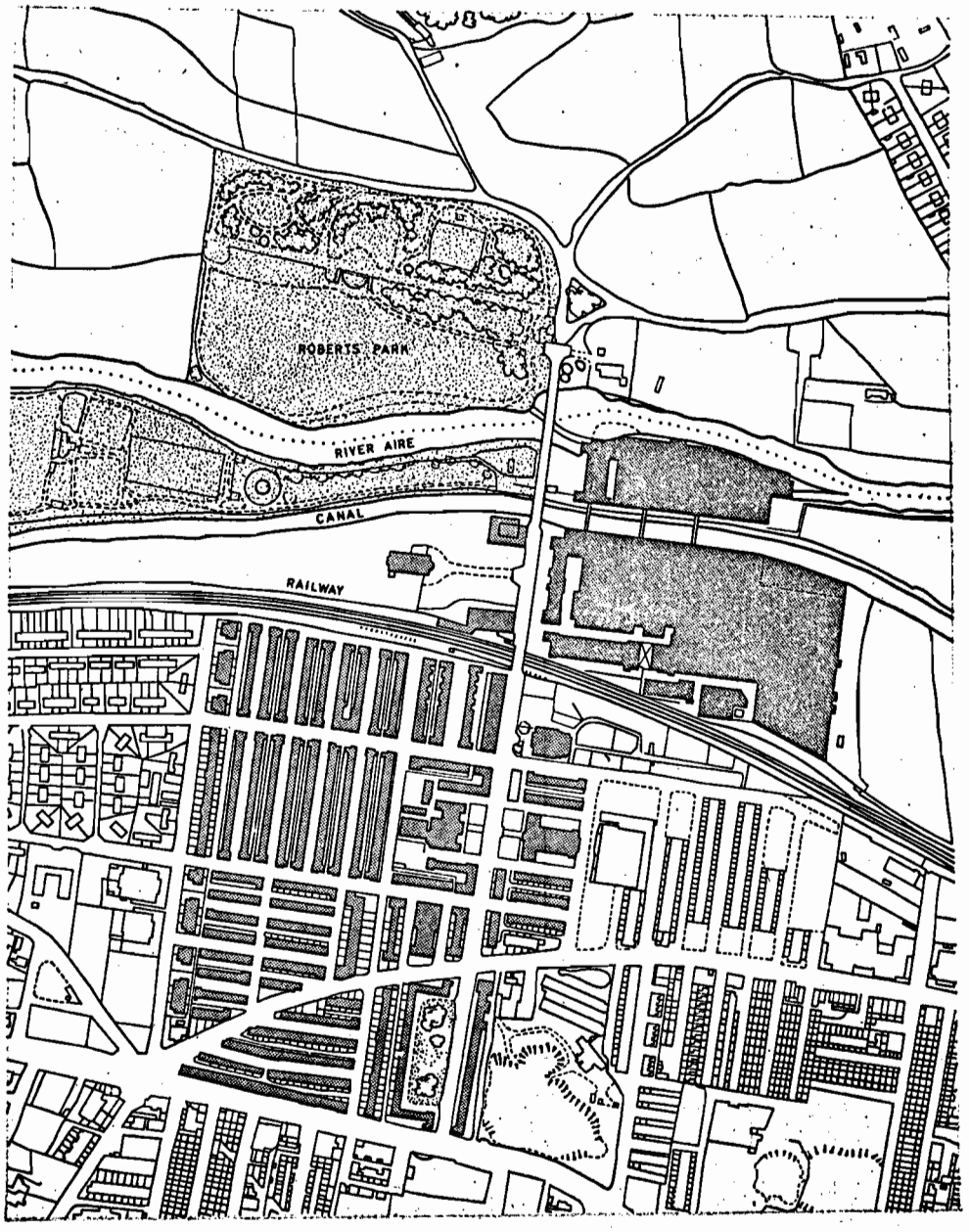

Fig. 22 Saltaire, Britain

was made to zone the town into various areas such as residential, factory, open spaces, etc.

There was another who rose above the throng at the end of the nineteenth century. He was Ebenezer Howard, a court stenographer. In 1898, he published a book entitled 'Garden Cities of Tomorrow' in which he expounded a new theory in town planning which would combine all the advantages of city life with the charms of the countryside. He also described a town in which the land would remain in sole ownership of thecommunity. The dwellings would be distributed about a large central court in which the public buildings would be located. The shopping centre would be on the edge of the town and the industries on the outskirts. The city would have a population of some 30,000 people in an area of 1,000 acres. Surrounding the entire city there would be a permanent belt of agricultural land of 5,000 acres. A radial-ring system of streets was established (Fig.23); the town was surrounded by a railroad to serve the country-oriented industries. Heavy traffic would thus be kept to the outside. A pedestrian scale of accessibility was created. Howard's permanent contribution to the field of city planning lay firstly in pointing out the advantage of planned development and growth of cities at a time when most thinkers felt this to be beyond the ken and skill of our civilization; Secondly, in suggesting

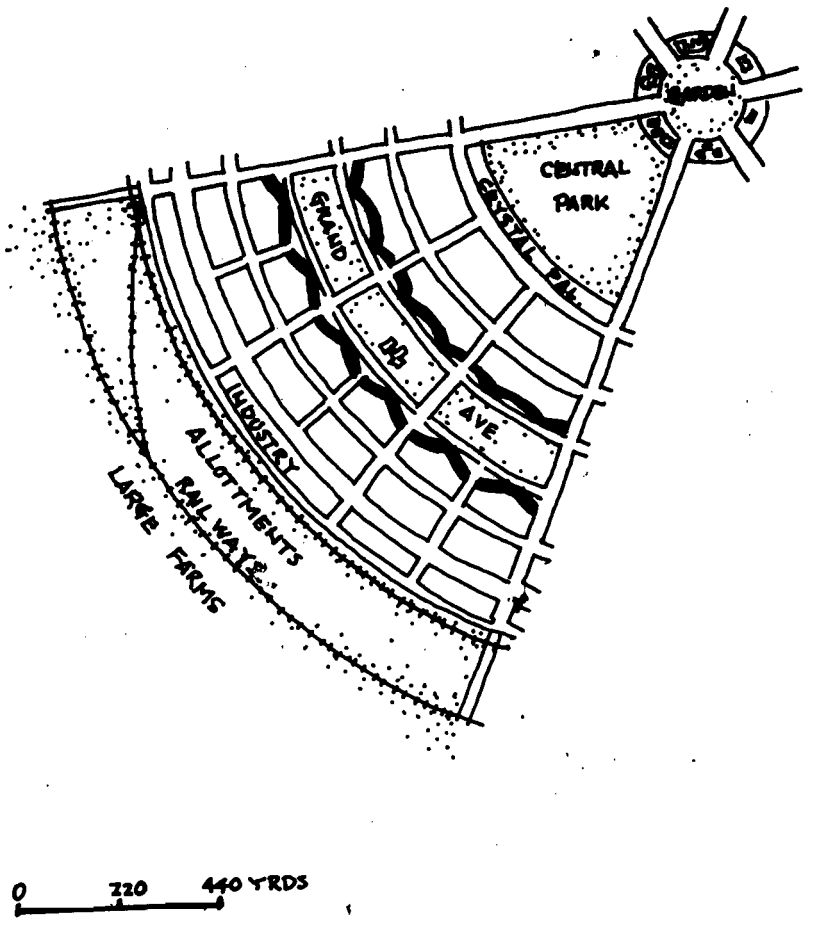

Fig. 23 Ebenezer Howard-Garden City

that the size of a city was a legitimate area of control, and thirdly, in establishing the ground work of the neighbourhood concept. His service as a prime mover in the development of Welwyn and Letchworth Garden cities in the first decades of this century could not be overlooked. Garden cities stood among the earliest systematic treatments of zoning land uses, the ideal of low density, and the preservation of inviolate green areas around towns.

Some industrialists in North America sought to improve the housing for their workers, probably the best known example being Pullman, Illinois (Fig.24) built in 1881. It was built as a permanent town in conjunction with the plant for manufacturing of pullman sleeping cars. The streets were laid out in the grid normal to all working class areas of that time. In the nineteenth century, the grid became oneof the basic layout patterns of farms, villages, towns, cities and counties in North America. Desirability of land was measured by its prospects for quick and profitably turnover. Subdivision practices were conveniently designed to enhance these prospects, and the pattern of future development of many cities was fairly well established in this package of the gridiron plan.

In Great Britain, early in this century, Raymond Unwin began to examine the typical English bye-Law street, the product

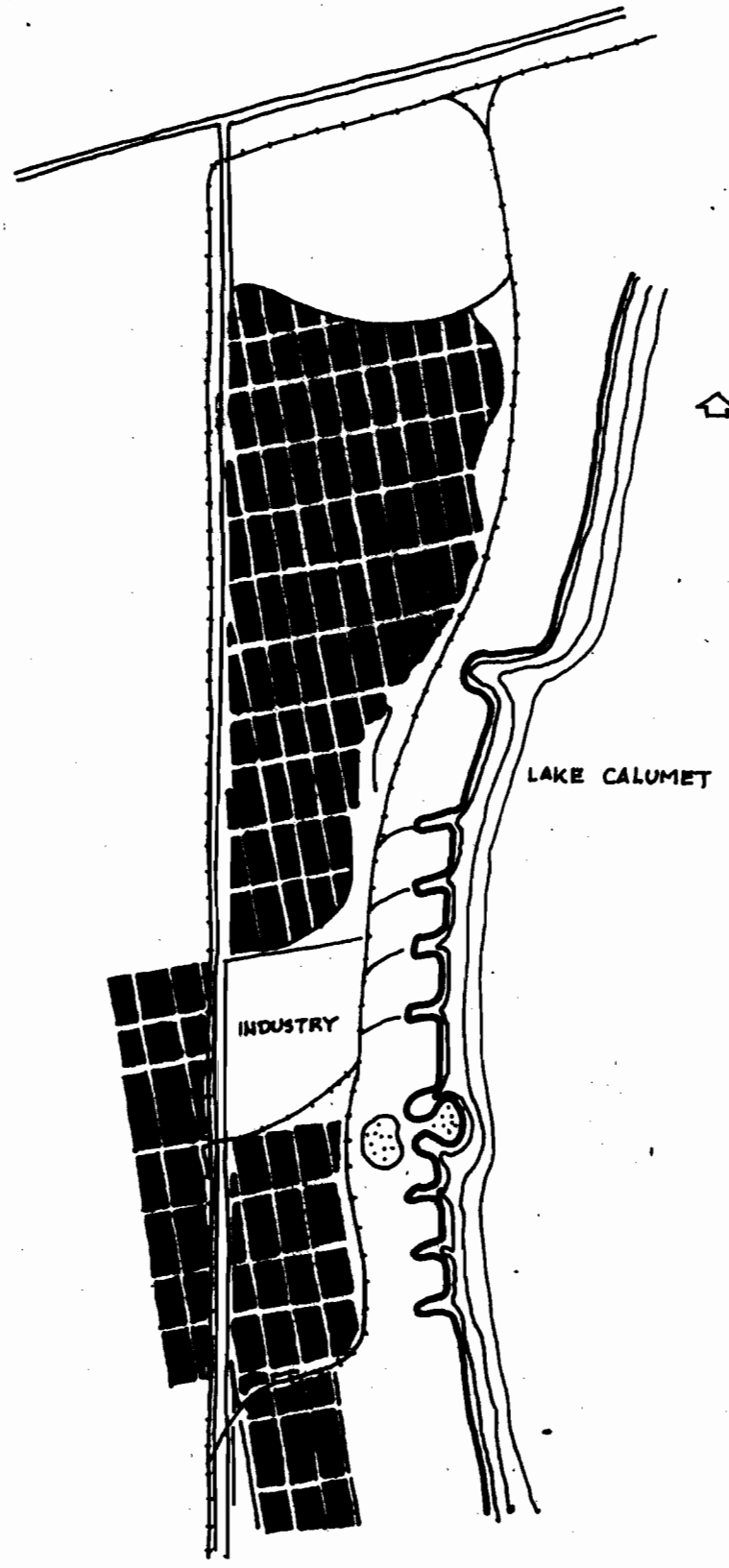

Fig. 24 Pullman, Illinois.

of England's earliest municipal regulations. These regulations provided for a minimum amount of street width, backyard, daylight, and sanitary facilities for each house. Streets were simple and straightforward to operate, but this simplicity had drawbacks, as it led to rigidity and monotony in the form of layout. Raymond Unwin compared this typical subdivision street system with a more open development using the cul-de-sac street. He demonstrated in his 'Nothing Gained by Overcrowding', that money which was thrown into excessive street acreage and expensive paving, could have been spent for better purpose by providing for the same amount of public space, in the form of internal parks and play areas. Commenting on this view, Lewis Mumford has the following to say:

'This analysis also had a certain retrospective merit: not merely did it account for the success of innovations in planning like the superblock and the cul-de-sac, but it likewise showed the soundness of those monastic and collegiate plans on the medieval pattern - The Temple and Gray's Inn in London, and the older colleges at Oxford and Cambridge -- that had created self-enclosed quarters, withdrawn from wheeled traffic.'(1)

In the designs for Letchworth and Welwyn, Garden city, as well as in some early garden suburbs such as Hampstead, two kinds of roads were distinguished. Some streets were intended

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(1) Lewis Mumford, The City in History, New York: Harcourt, Brace & World, Inc., 1961, p. 498.

for through traffic, others were to permit access to individual buildings. A separation of this kind, exemplified by the cul-de-sac, enabled houses to be grouped together or around small squares and generally to be placed in accordance with needs, e.g., for privacy, freedom from traffic and noise, and for sun-lighting.

STREET PATTERNS OF THE MOTOR AGE

During the first quarter of this century, with the absence of improvement in the physical and social conditions in metropolitan areas of the United States, Clarence Perry framed the concept of the neighbourhood unit (Fig.25); an organizing social nucleus, which provided the necessary facilities for working and co-operating in all manners of neighbourly activities. Perry was considerably influenced by the zoning, settlement house, and various other reform movements.(1) His work also reflects the increasing interest shown in rationalizing municipal services such as schools. His original essay was written as part of the Regional Plan of New York, as a guide to the development in new suburban areas.

The principle of Perry's neighbourhood unit was to bring within walking distance all the facilities needed daily by the home and the school, and to keep outside of this pedestrian area the heavy traffic arteries carrying people or goods that had no business in the neighbourhood. The playground for school children should not be more than a quarter of a mile from the houses it served; and the same principle applied with variations to the distance of the primary school and of local marketing area. Both the population and the peripheral spread of such a community

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(1) Thomas A. Reiner, The Place of the Ideal Community in Urban Planning, Philadelphia: University of Pennsylvania Press, 1962, p. 60.

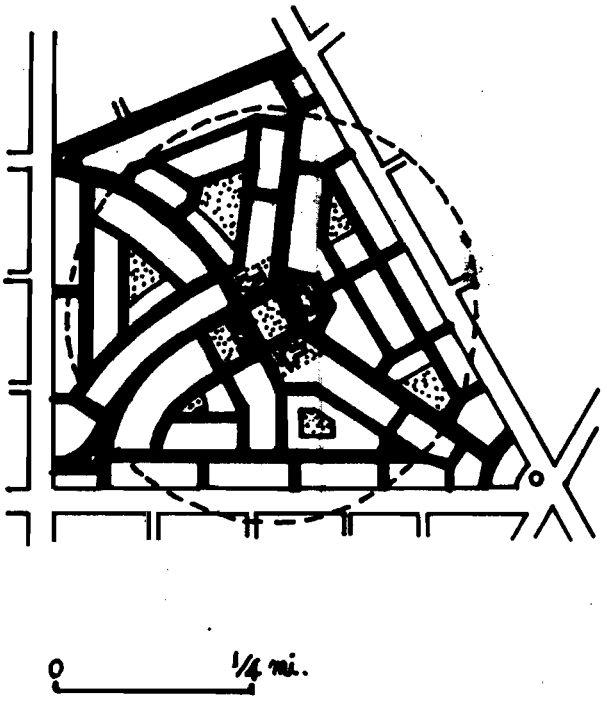

Fig.25 Clarence Perry - The neighborhood unit

was limited and might be physically defined by either a road system or a greenbelt or both. Perry placed the population of such an urban neighbourhood at about five thousand: large enough to supply a full variety of local services and appurtenances, always allowing for a generous flow across the borders, for he regarded this neighbourhood unit idea as a sealed-in unit designed to prevent intercourse with the rest of the city. In his concept of the neighbourhood Perry had identified the fundamental social cell of the city and established the principle of cellular growth(2).

The explicit aim of the street system in Perry's neighbourhood idea was the reduction of traffic within the unit. A hierarchy of circulation routes was proposed, with arterial through streets forming the unit's boundaries, major and minor streets in the interior. The latter are designed so as to discourage through traffic and only to bear the number of vehicles necessary to serve the immediate vicinity. Perry's neighbourhood unit formulated the first realistic protection from the automobile. Its influence became evident in the work of most planners active today.

In the layouts of Sunnyside Gardens, N.Y. with its gridiron street system, and Radburn, N.J. on the agricultural land, Henry Wright and Clarence Stein demonstrated a new urban pattern developed from the valuable ideas of Perry and the universal appli-

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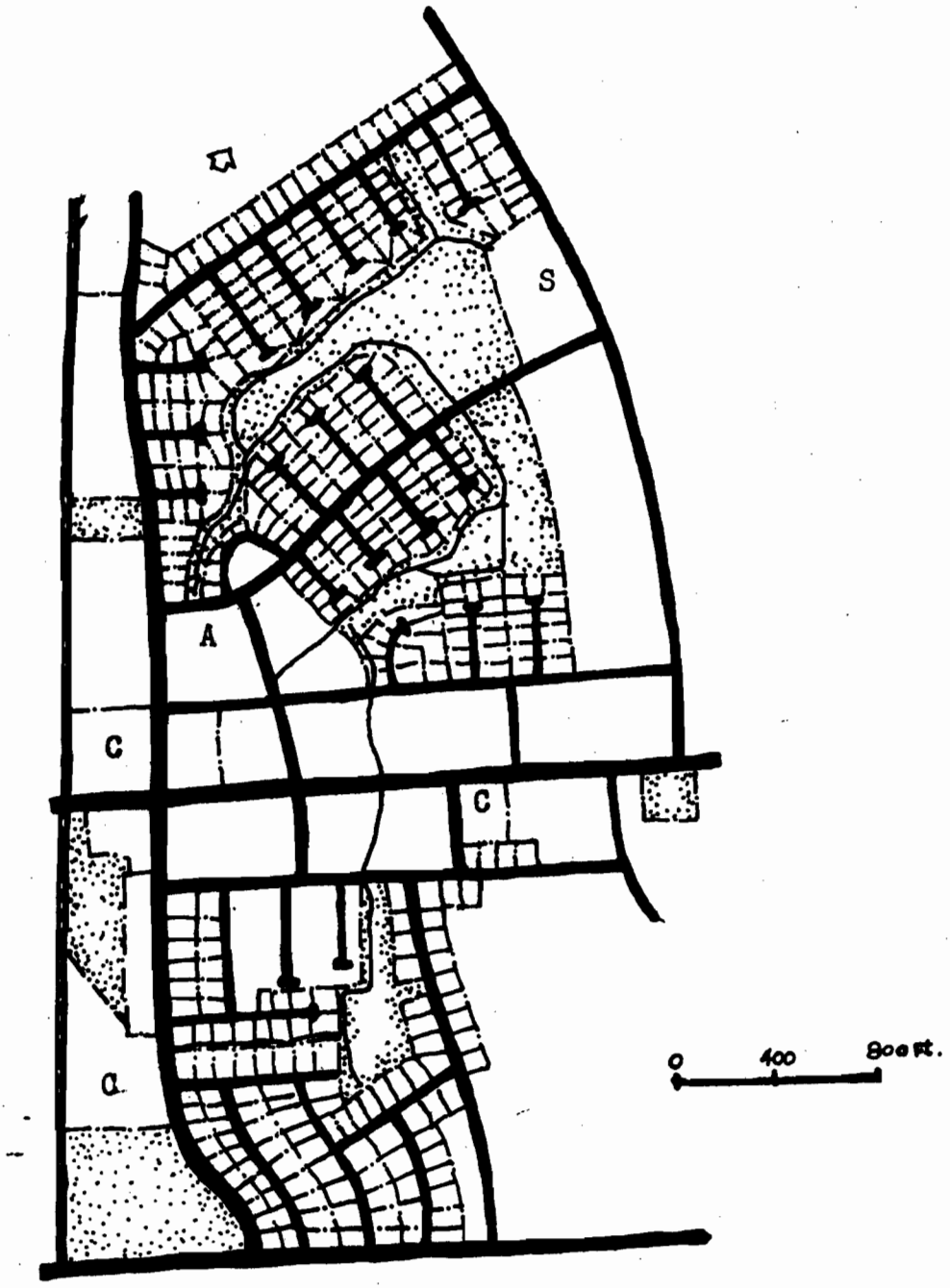
(2)Lewis Mumford, City in History, New York: Harcourt, Brace & World, Inc., 1961, p. 501.

cation of the experience which they had consciously projected.

Neighbourliness and comeliness were the qualities which Clarence Stein and Henry Wright brought into their design. Before Perry wrote his able treatise on 'The Neighbourhood Unit', Stein and Wright had already carried out many of his theoretic suggestions in Sunnyside Gardens. They insisted upon the advantages of the group houses used at Sunnyside, to improve the planning of both dwellings and the space about them. They showed the improvement in land planning with the group houses and their green pedestrian interiors in comparison with the dreary, monotonous rows of cheap and poorly planned single-family flat buildings and their wasteful and useless side yards. They contributed much to the enlightenment that emerged in the 1920 decade and the early thirties.

Layouts in which there was complete segregation between the vehicle and the pedestrian were often called Radburn, after the American garden city of that name. Built in New Jersey from 1928, Radburn was one of the first serious attempts to come to terms with the motor-car. The layout plan (Fig.26) was based on groups of detached houses round culs-de-sac which were placed in regular series at right angles to the road systems. What was quite revolutionary was that parallel to the road system there was a layout of completely separate pathways. It provided uninterupted



A Apartment
C Commercial
S School

Fig.26 Radburn, New Jersey

pedestrian access to a continuous park strip, leading to large common open spaces within the centre of the super-block. Underpasses separated pedestrian walks from traffic roadways. The houses were designed so that living rooms and bedrooms faced onto the pathway, (which became the front of the house), and the service rooms faced the roads.

The Greenbelt towns -- Greenbelt (Fig.27) near Washington, D.C., Greenhills (Fig.28) near Cincinnati, and Greendale (Fig.29) near Milwaukee -- built under Stein's general guidance and application of garden court and cul-de-sac layout, were beautiful solutions to the practical problems of domestic economy and family life. The idea of a permanent belt of agricultural land surrounding these communities was borrowed from the Garden City pattern of Ebenezer Howard. As works of art, they were in the tradition of the Garden City movement, brought up-to-date to fit the motor age.

'The publication of Clarence S. Stein's 'Toward New Towns for America' was a landmark in the literature of community planning and housing. The great experiments in town-building with which he had been associated, particularly Radburn and Greenbelt towns, were already widely known and have already left their mark upon many cities.'(3)

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(3) Humphrey Carrier, The Excellent Experiments, Ottawa: Community Planning Review, Vol. 11, No. 2, May 1952, p. 49.

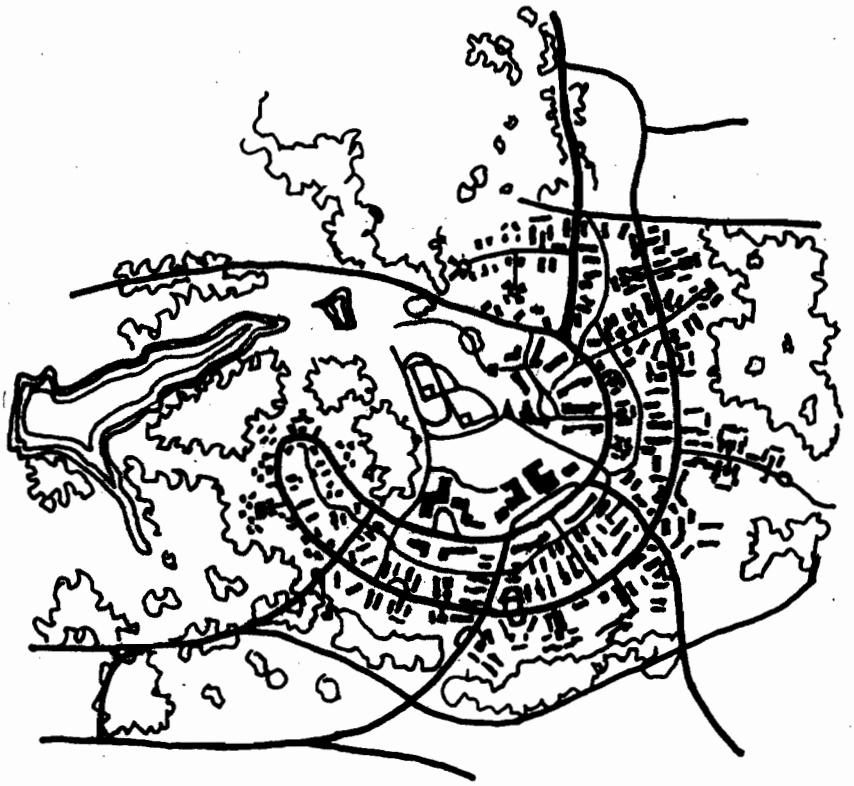

Fig. 27 Greenbelt, Maryland

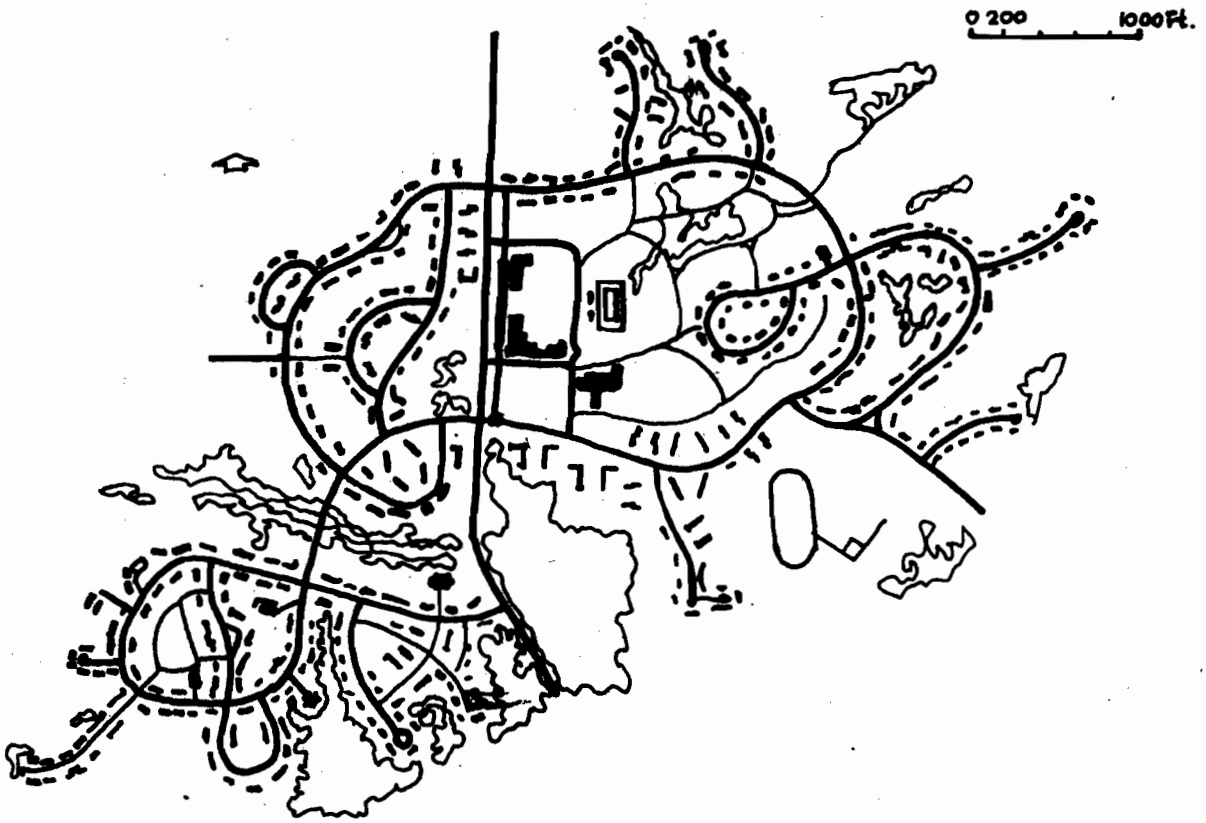

Fig. 28 Greenhills, Ohio.

Although Parker and Unwin had explored the possibilities of the super-block in the early English Garden Cities, these English planners never erected the super-block into a universal principle of laying out a modern residential quarter, hence they never carried it through as systematically as did the planners of Radburn. Similarly, Parker and Unwin had, in Hampstead, created on a limited scale the continuous inner park, but they did not follow this to its logical conclusion by interweaving this continuous green throughout the whole development.

By 1941, the Radburn idea had achieved its most characteristic expression. At Baldwin Hills (Fig.30) all the original elements of Radburn reappeared -- with super-blocks, homes facing central greens, and the pedestrians being completely separated from the autos. The most significant of this scheme was that the culs-de-sac of the Radburn type had been replaced by a concentrated but adequate garage court design. The scheme was so full of excellent detailed planning that a careful study of it was of the utmost advantage to planners for man and motor.

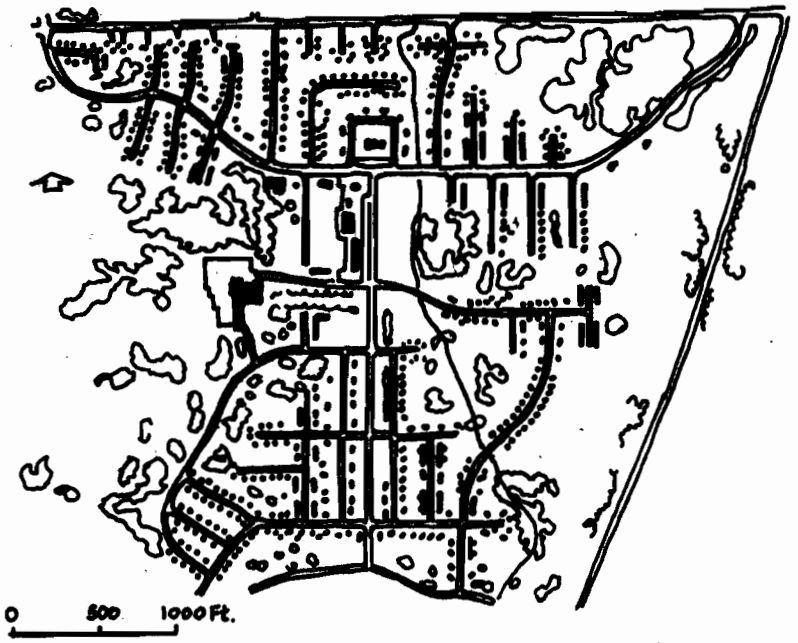

Fig. 29 Greendale, Wisconsin

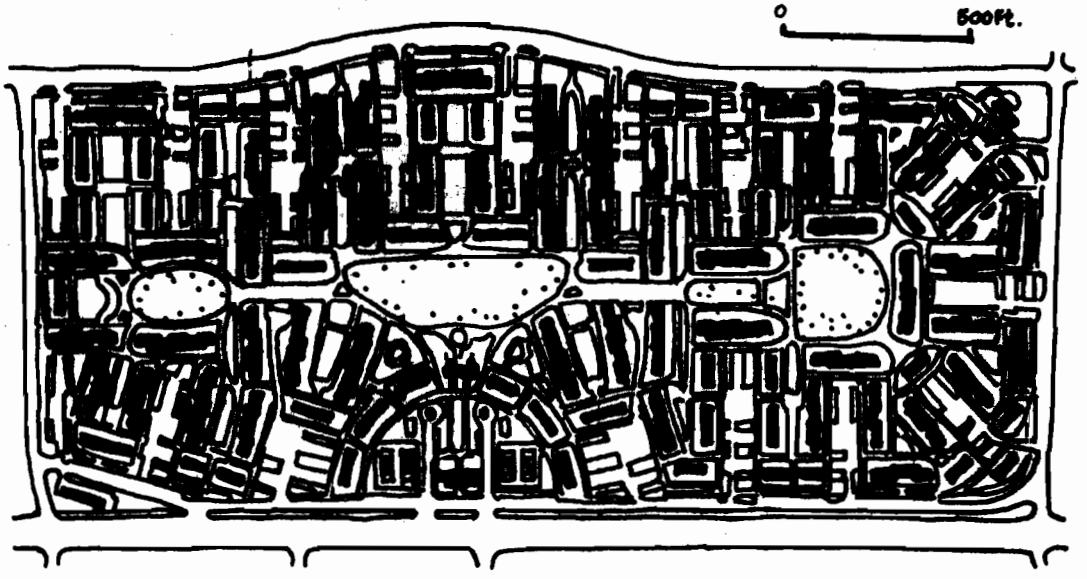

Fig. 30 Baldwin Hills Village,
Los Angeles.

PART II CLASSIFICATION OF STREET PATTERNS

BY STRUCTURAL FORM

GRID SYSTEM

Rectangular Grid

There is no such thing as an ideal pattern or a traditional arrangement of streets that is suitable for general adoption and adaptation to various conditions. Very often they occur as a rectangular grid which is the system more commonly used for patterns of streets. It has been criticized for its visual monotony, for its disregard of topography, for its vulnerability to through traffic, and for its lack of differentiation between heavily travelled and lightly travelled ways, which prevents specialized design and the economical use of space and paving. These criticisms are not inherent in the pattern itself but in its particular use. Heavy or through traffic can be directed on to a particular line of the grid, and monotony can be avoided by the variation of the building and landscape pattern.

However, the rectangular pattern has the advantage of good orientation, simplicity, and clarity, as well as convenient access, particularly to strangers. Its obvious aesthetic defects could be remedied by maintaining clarity, if the grid size is variable and if the major axes depart slightly from absolute rectilinearity. If the rectangular grid has heretofore led to

too numerous intersections hampering traffic flow, there is no reason why fewer streets and super-blocks should not set the pattern, such as L. Hilberseimer's two proposals in the re-planning of the Chicago Marquette Park.[1] Its layout pattern is determined by the usual rectangular system characterized by numberless intersections. Connected with this residential area is a park which serves as its recreation space. The many street intersections make it dangerous for children to go to the park and to school. Hilberseimer has tried to eliminate the defects and to meet the residents' need for safety by two proposals. In his first proposal, the danger is eliminated by closing some of the streets and removing others (Fig.31-a). This enables the residents and their children to reach park and school without crossing a single traffic street. This can be achieved with relatively little expense. In the second proposal, he eliminates a number of blocks and extends the park, bringing it into closer connection with the residential area. The school can be placed in the new park strips. Safety would everywhere prevail. This is an excellent example of transforming a rectangular street pattern into a well-functioning system.

The blocked grid is a further refinement. In order to discourage through traffic and to allow the differentiation of

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(1) L. Hilberseimer, The Nature of Cities, Chicago: Paul Theobald & Co., 1955, p. 227.

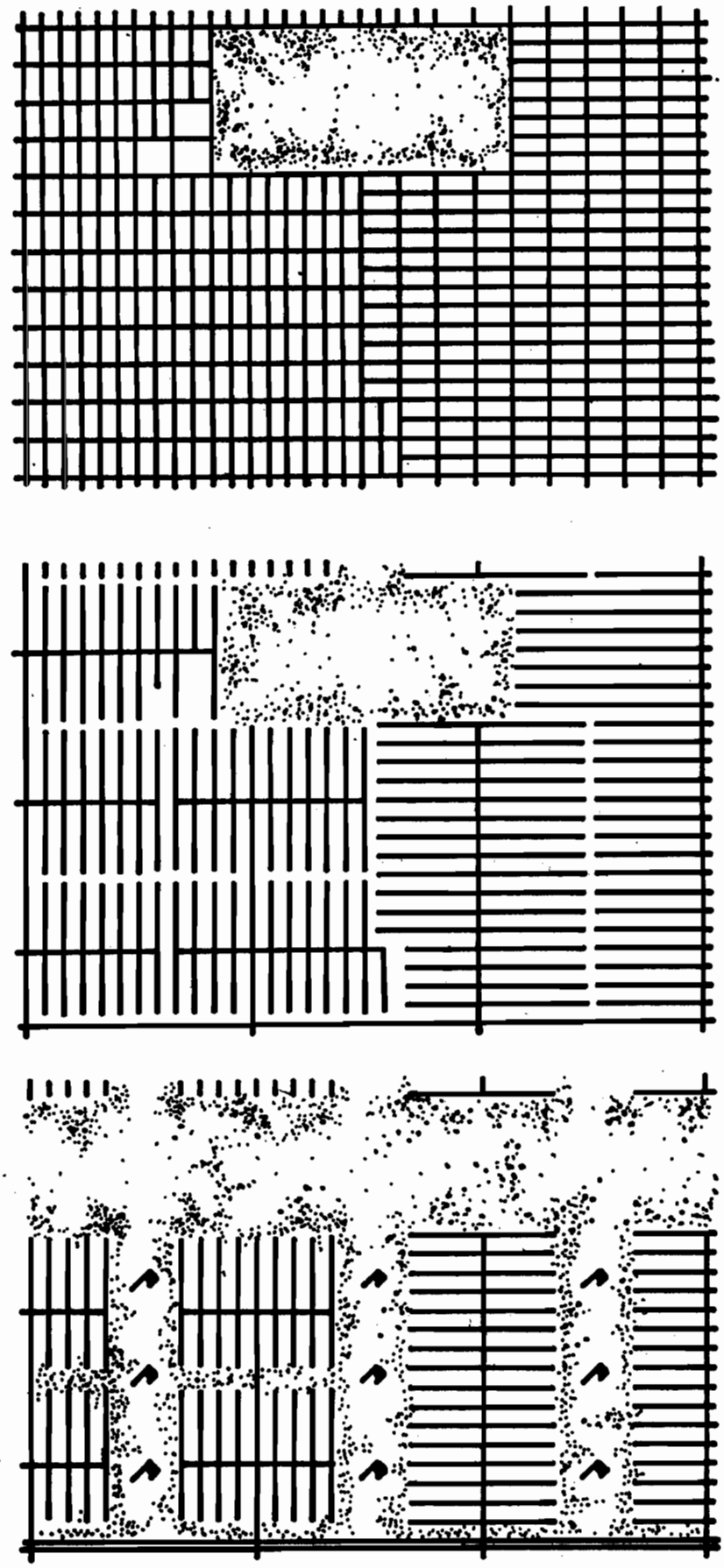

Fig. 31-a Chicago Marquette Park and L. Hilberseimer's two proposals

paths, occasional interruptions are made in the grid leaving the entire grid pattern intact within the area as in the subdivision plan of Beaconsfield, Montreal Island. (Fig.31-b)

Fig. 31-b Beaconsfield of Montreal Island

Curvilinear Grid

The grid sometimes may be curved to fit topography, to discourage through movement, or to subdue the monotony of parallel streets stretching to infinity. The nature of topographic conditions may often lend itself to picturesqueness or surprise in street layout. Streets designed in curves or broken straight lines, fitted as close as possible to the surface frame up a most natural composition. In some cases a unity of design may be obtained by the seguential curvature of the streets themselves and their flowing relation to each other or to the ground. For example, at Nall Hills, Kansas City (Fig.32) and Carrollton, St. Louis (Fig.33), the lines of the natural rolling countryside and the contours have been well utilized through the curvilinear grid layout. However, the more exaggerated pattern of the curvilinear design may end up with a violently swirling street system such as in Nassau County, New York (Fig.34) which has lost the vestiges of order and the clarity of orientation.

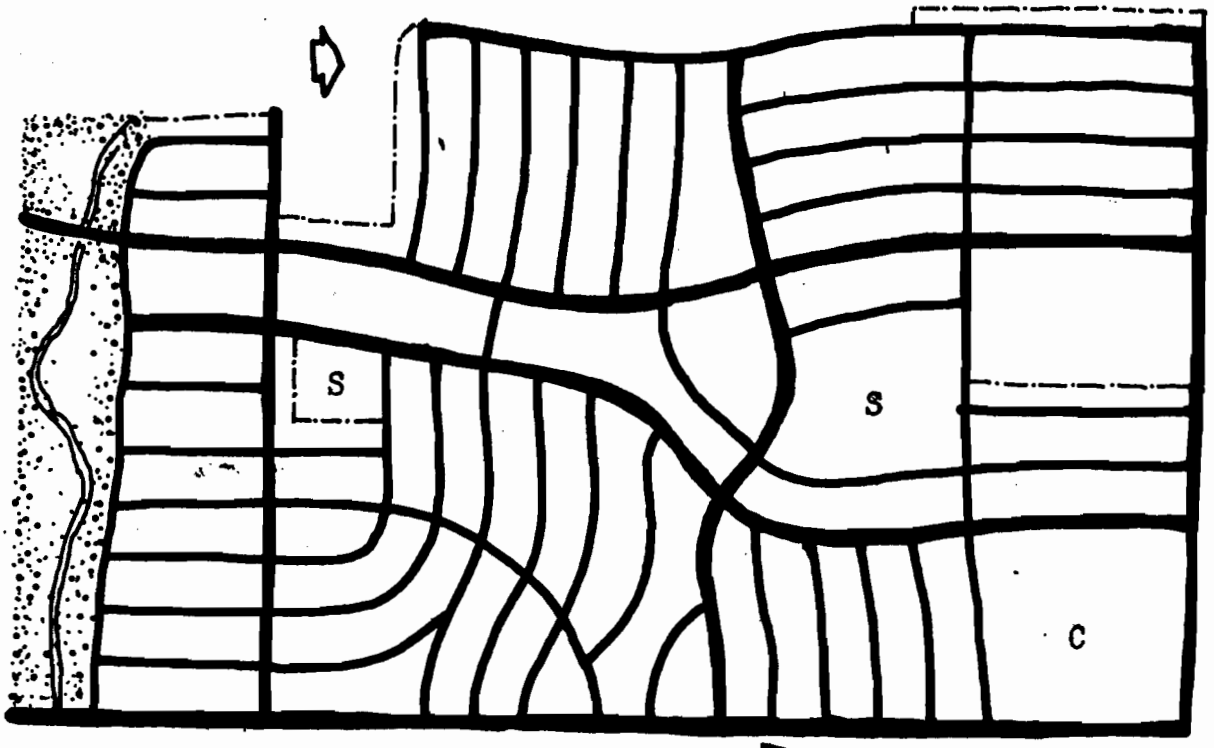

Fig. 32 Mall Hills, Kansas City

C Commercial
I Institutional
S School

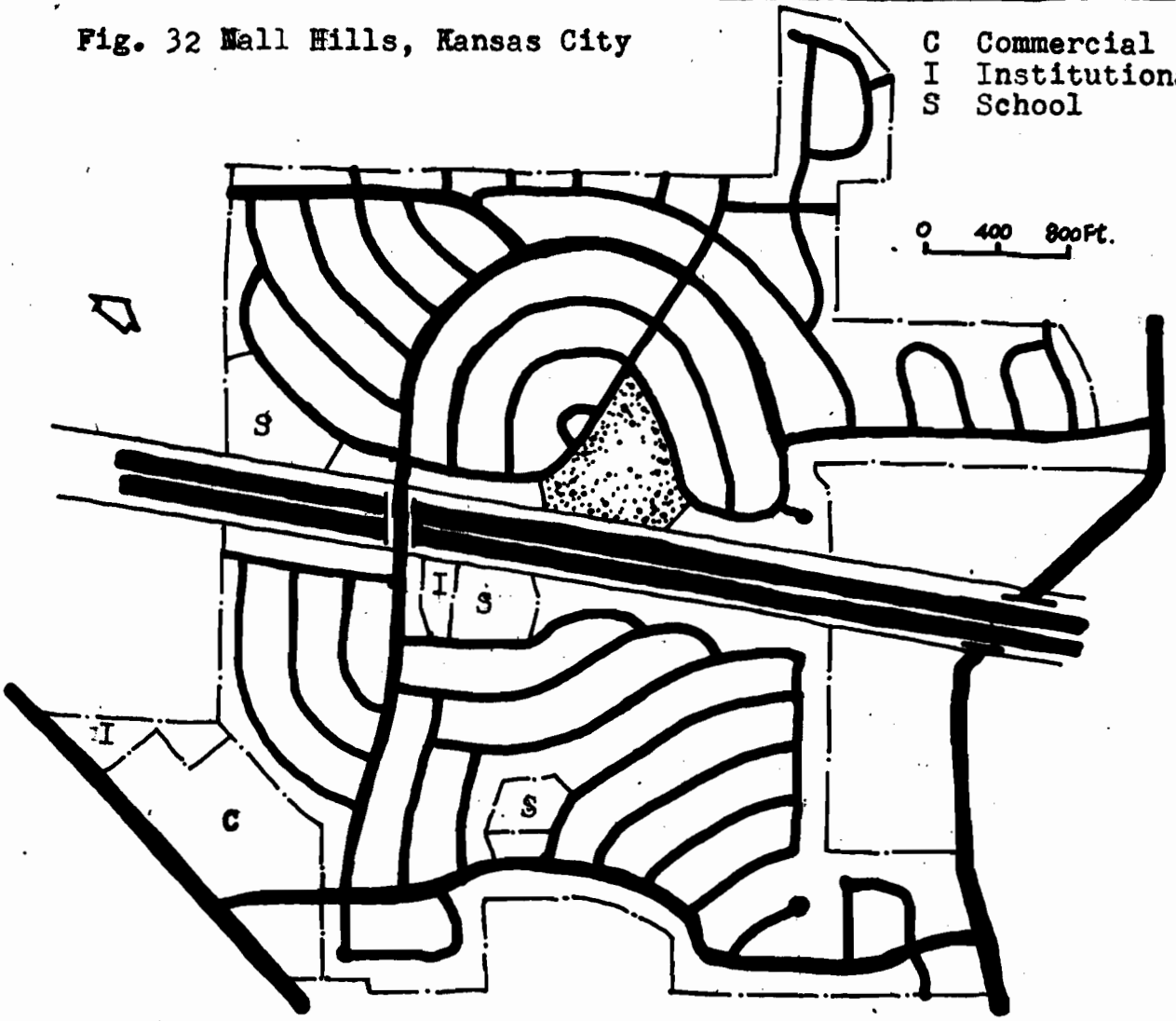

Fig. 33 Carrollton, St Louis

Fig. 34 Nassau County, N. Y.

The Hexagonal Grid

Another variation of the grid system, which has captured the interest of many planners, is the hexagonal grid. Under this system ~~residential~~ blocks are arranged in the form of a hexagon or six-sided figure. Proponents of this pattern claim the following advantages to its credit:

1. From the point of view of public health, the hexagonal system is capable of giving to the public the maximum amount of sunlight. This is true especially when the long axis of the buildings run north and south (Fig.35-a). Moreover, it helps relieve congested living conditions by providing more parks and playgrounds.

2. From the point of view of traffic, the hexagonal pattern enables circulation to flow along with greater ease and safety. This is accomplished by the provision of three-way, wide angle vision at street junctions and the reduction of collision points to three vs. sixteen in a rectangular grid(1).

3. Economy-wise, the hexagonal system requires less capitalization because it requires fewer and shorter streets.

4. From an aesthetic point of view, the street vistas of the hexagonal grid are more charming because of the alternate

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(1) Noulan Couchon, Memorandum and Diagrams re Hexagonal Planning, Traffic Intercepter and Orbit. , Ottawa: Journal of the Town Planning Institute of Canada, Feb., 1926, Vol.V, No. 1, p.11.

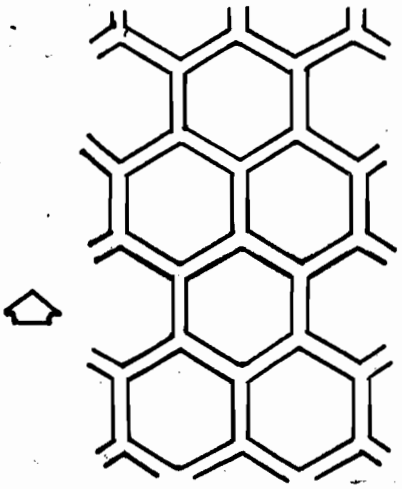

Fig. 35-a

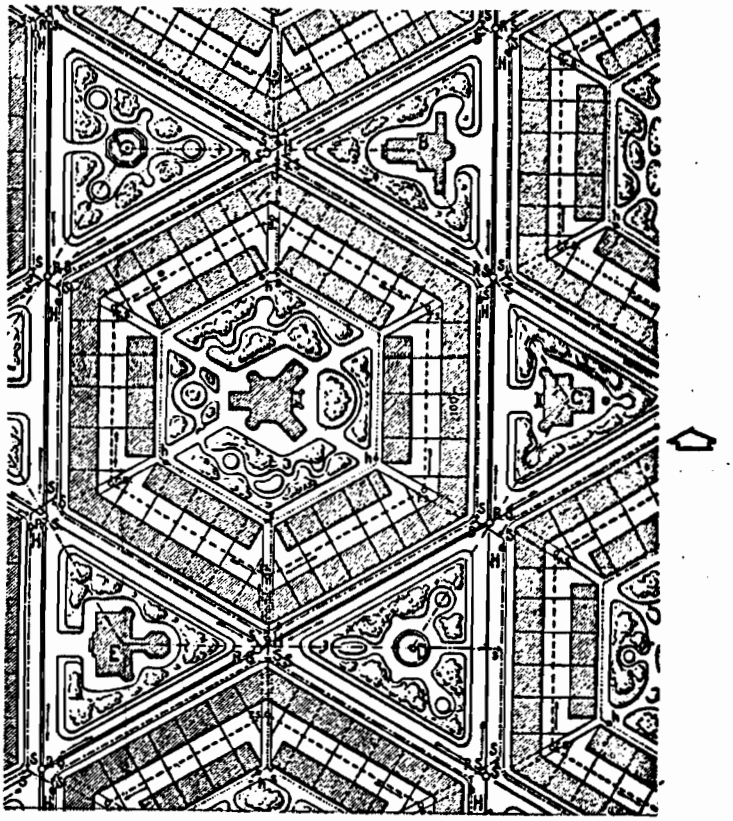

Fig. 35-b Suggested hexagonal plan by Herr R. Müller

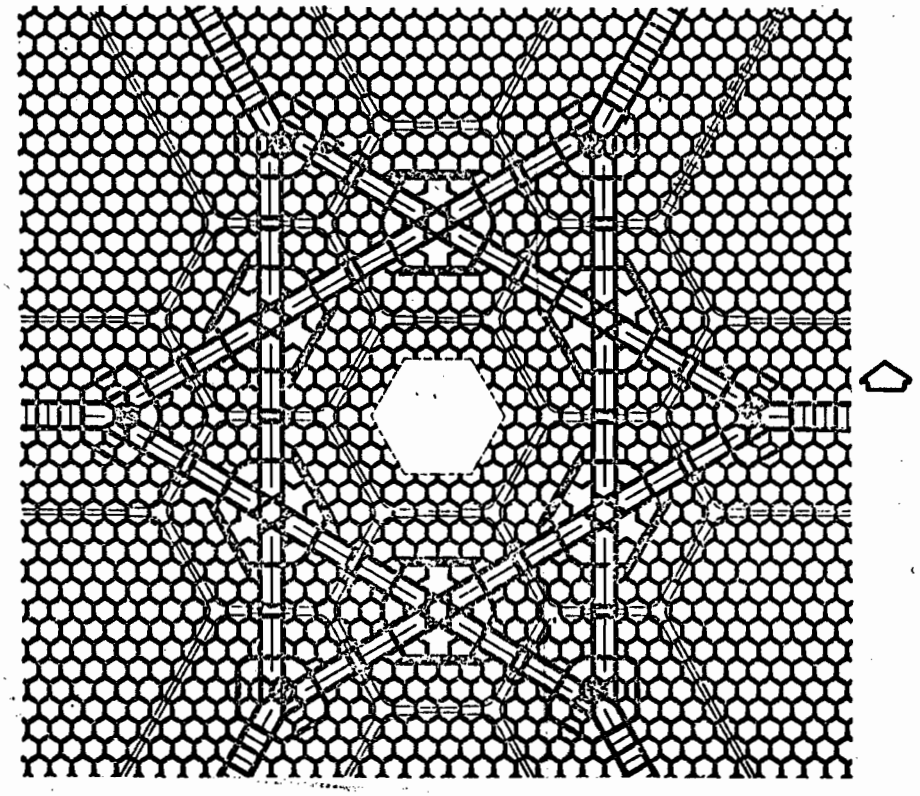

Fig. 35-c Suggested hexagonal plan by Noulan Cauchon

grouping of buildings and trees.

The hexagonal system, nevertheless, has its shortcomings. When the volume of traffic has grown beyond the capacity of those circuitous streets, straight-line connecting roads will have to be superimposed on the grid. This often results in the formation of oddly shaped blocks, as well as intersections more complex than those of a rectangular grid. Moreover, the very neutrality of direction of the hexagonal pattern can become confusing and lead to poor orientation.

Early applications of the hexagonal concept can be found in the design of Rudolph Müller of Vienna, who advocated the arrangement of hexagonal blocks in such a way as to leave all sides as continuous straight streets (Fig.35-b). The defect of this arrangement is the formation of triangular interstices which are economically wasteful of bounding streets and public services. Also, the main streets will cross each other at an acute angle, thus losing the benefit of the three-way, wide angle junction of the normal hexagonal arrangement.

A more recent protagonist of the hexagonal grid is Noulan Couchon of Canada. He favours the adoption of the hexagonal block as the basic residential pattern, with ample latitude for specialized differential and rectangular design for business,

commercial or industry purposes. To improve the efficiency of the street system, Couchon proposes the development of a hexagonal system of major arteries, both surface and intercepter.[(2)] In Fig. 35-c a field of hexagonal residential blocks and streets is shown, served by a twin system of surface arteries for local distribution and diffusion, circumscribing a large open area. Traffic intercepters help to accelerate through traffic.

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(2) Ibid., p. 11-16.

BY STRUCTURAL FORM

RADIAL SYSTEM

The radial form is one of the earlier concepts of town design (cf. the ideal plan of Victoria designed by J.S. Buckingham in 1849 and the Garden City idea by E. Howard in 1898 as discussed in Part I). The radial plan is adopted as one of the principal forms which is applied to all scales of planning.

The radial pattern consists essentially of a series of streets spreading out from a centre which becomes the nucleus of the whole area. This system gives the most direct lines of travel for centrally directed flows. It is a relatively rigid system in comparison to the grid. However, the grid system does not allow easy access to the central activity.

This radial pattern is found in the vicinity of Quebec City, Canada. It is the product of Jean Talon's Experiment[1] in 1665 to create a nucleated village pattern. The plan and design are "in the form of a square of forty arpent sides (about 1½ miles). Each side was divided into ten parts of four arpents each (46.5 rods), which formed the bases of forty triangular farms of forty square arpents (34 acres). In the centre was a small square, with a road around it called the 'Traite-Quarré' (square line). Inside the traite-quarré were found the church,

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(1) Barkham, Brian, The Development of Land Settlement and Rural Architecture in the Province of Quebec, Montreal: McGill University Thesis, 1955, pp. 25-33.

cemetary, flour windmill and flour watermill; the inhabitants' houses were on both sides of the traite-quarre."(2) Talon set about to substantiate this plan by founding three model villages of Charlesbourg (Fig.36), Bourg Royal and L'Auvergne in the inland, all of which situated a few miles northwest of Quebec. These 'model' villages had one serious shortcoming, namely, their remoteness to the river which was depended upon as a source of food and for transportation in the old days. The habitants' dislike of triangular fields did not further their popularity either. Thus, it is not surprising that no village of similar patterns were planned thereafter in this Province.

On certain occasions, rings may be added to the radial system to make a radio-concentric net. In its outer reaches and at a large scale, this net acts like a rectangular grid. The arrangement seems to permit the best internal interaccessibility, while at the same time, it can provide a way to bypass the core when necessary. For example, a ring-and-radial pattern proposed by two site planners, S.E. Sanders and A.J. Rabuck(3), offers a strongly articulated neighbourhood basis. The plan (Fig.37) envisages a business core surrounded by high-density residential neighbourhoods. From this core several sectors of medium- and low-density developments radiate, and in-between these sec-

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(2) Deville, E., Radial Hamlet Settlement Schemes, Ottawa: Journal of the Town Planning Institute of Canada, 1923, II, p. 10.

(3) Sanders, Spencer E., and Rabuck, Arthur J., New City Pattern. New York: Reinhold, 1946.

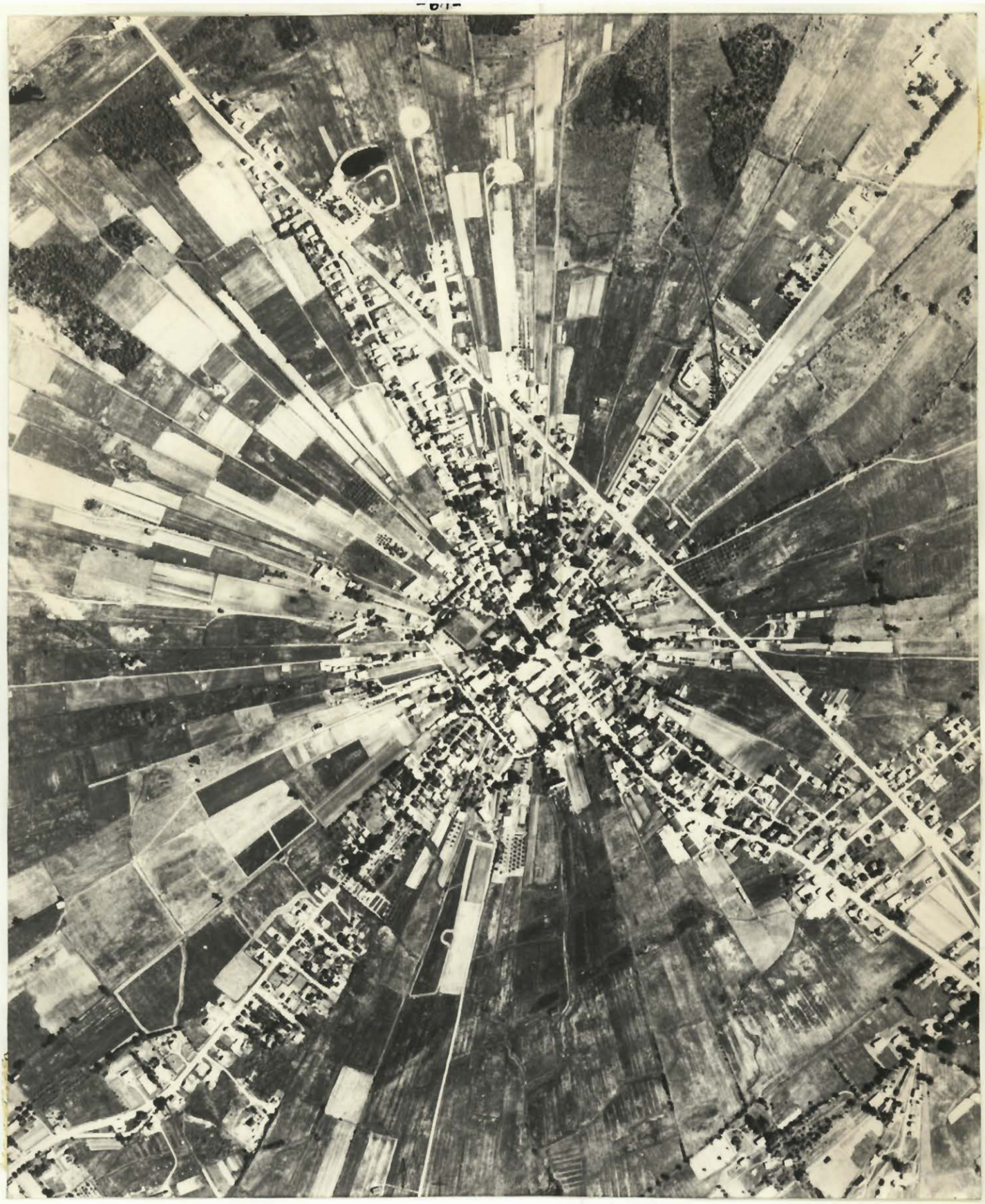

Fig. 36 Charlesbourg, Quebec

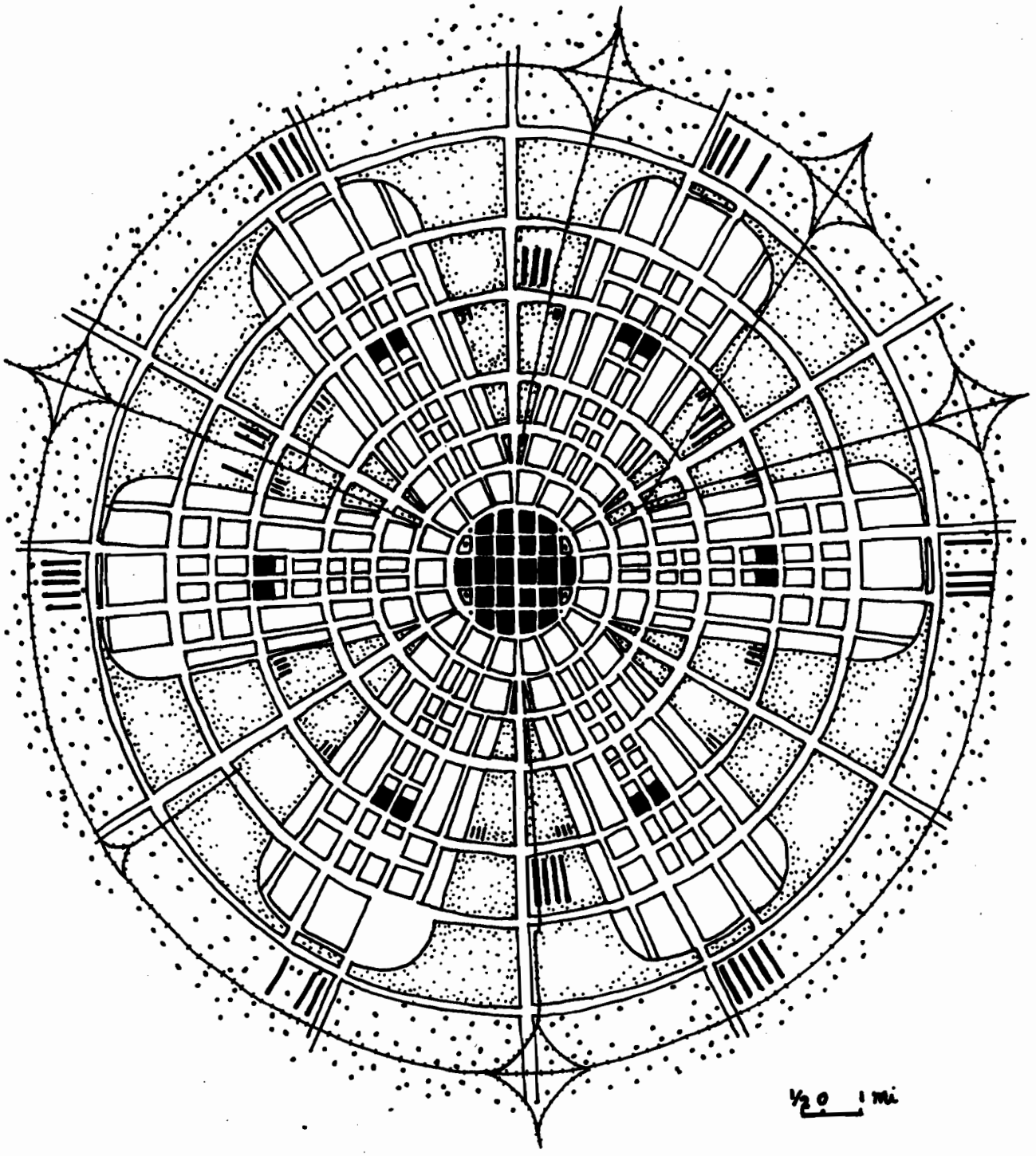

Fig.37 S.E. Sanders and A. J. Rabuck, New City Pattern, 1946

tors open land of various scales is found. Commercial and public facilities are distributed on a hierarchial pattern. Control of form, urban growth and density are much streesed in this plan. The gridiron is the organizing principle at an intermediate scale within each residential sector. The limited numbers of accessible highways bear the bulk of vehicular traffic flow. There is an emphasis on freedom from traffic within the neighborhood.

When the radial pattern combines with the rectangular pattern they may provide the most convenient plan for the circulation of traffic. The best way to combine both patterns is to superimpose a right-angled arrangement of streets on a radial system of main traffic route, in the form of a spider's web, such as the planning of the town of Mount-Royal, Montreal, (Fig.59 discussed in Part III). Another example is that of Thomas Adams[3], in his design of a residential city in 1934. His proposed street plan (Fig.38-a) is a combination of an over-all radial-circumferential system and a rectangular grid serving to define neighbourhoods. The scheme features clearly distinguished land-use area: the civic and commercial core surrounded by a major residential sector and, on one side, there is an industrial area. Green spaces interpenetrate the residential neighbourhoods which resemble Perry's design and each unit focuses on its school. This design

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(3) Thomas Adams, Design of Residential Areas. Cambridge: Harvard University Press, 1934, pp. 122 - 146.

calls for an orderly replacement of the chaos characterising the land-use distribution in urban areas. Such concepts have become accepted by planners. Many of the plans prepared since then bear close resemblence to this scheme.

Another application of the radial pattern was worked out in 1946 by Frank Sharp, a builder in Oak Forest, Houston, Texas (Fig.38-b). The scheme has two shopping centres surrounded by residential areas. From the shopping centres, main streets radiate in all directions to be intersected by numerous curved streets meandering through the whole area. While this system of street layout affords a great deal of traffic convenience on the one hand, it has its obvious weakness on the other. The fact that there are too many intersections throughout the whole area gives rise to an element of danger for pedestrians.

The radial pattern is by far the best pattern which can produce many traffic conveniences. However, the application of this street system to residential areas requires careful consideration because it provides no means of preserving the individual's safety and privacy, and therefore should not be adopted without good reason. It is a system that requires a centre of some importance to justify its use, for without this all the roads would lead to an insignificant place where nobody wants to go.

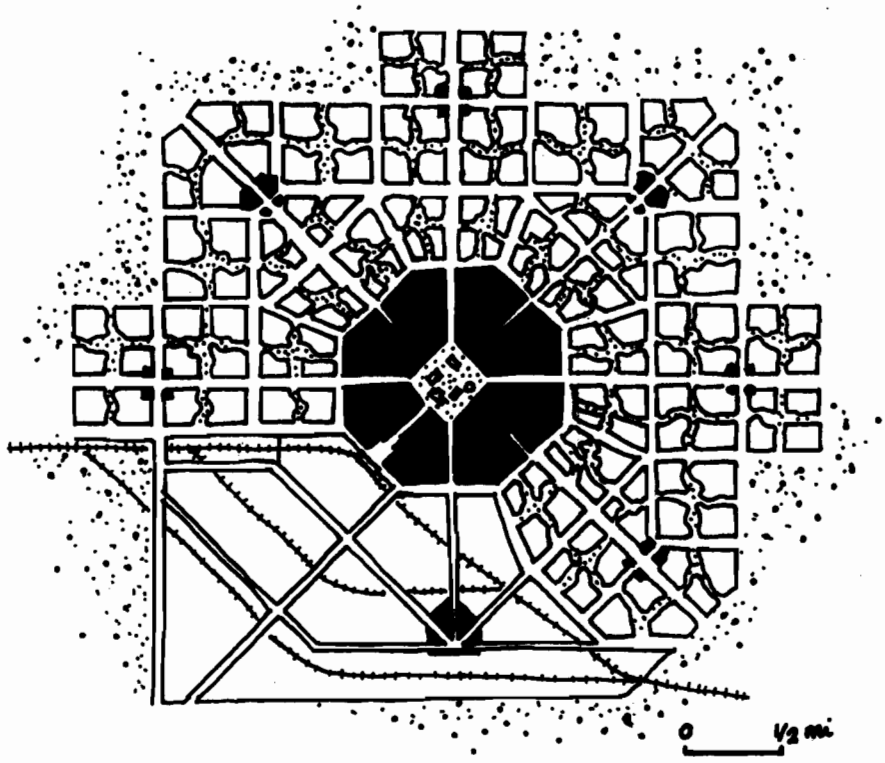


Fig.38-a T. Adams, 1934. The City

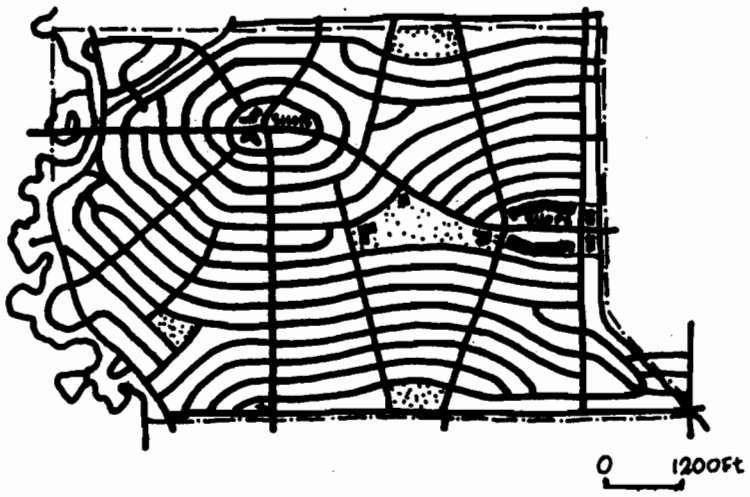


Fig.38-b Oak Forest, Houston, Texas

BY STRUCTURAL FORM

CLUSTER-TYPE SUBDIVISION

Cluster development is the development which has common properties in a dispersed network pattern. In such developments, a large proportion of the individual homesites abut the common property. Featured in many of these is the super-block -- a large land area with a peripheral street, and houses clustered around internal open spaces. Culs-de-sac or loop streets may intrude into the super-block but, regardless of pattern, a high percentage of lots abut the common open space or are closely related to it by sight or short walkways. In recent years, these have come to be called cluster-type subdivision.

In recent years the necessity for economy, for privacy and for freedom from the noise and vibration of street traffic, and the desire for architectural effect in grouping of small houses, have led to the increased use of the cluster-type subdivision in new residential developments. A pioneer cluster development in Fair Lawn, New Jersey, Radburn (Fig. 26 discussed in Part I) is known to urban planners and developers the world over. Radburn is most significant for its super-block plan with internal open space. It is also significant for the arrangement of group houses around short streets or parking yards withdrawn from the

circulation streets.

A large cluster of homes arranged in groups fronting on loop streets (Fig.39,40) and culs-de-sac (Fig.41,42) have direct access to a common area at the super-block's centre and to wide collector streets at the perimeter. Centralized in the super-block, the common area is close to all homes via safe walkways, and serves to strengthen the vitality of the residential neighbourhood. The efficiency of cluster planning cuts street and utility costs substantially by reducing utility runs, and creates a relatively efficient network of streets and utilities. In addition, the cluster situation is conducive to a more gregarious neighbourhood.

This type of pattern may require substantially longer vehicular travel to connect any two points. This criticism may be salvaged by reference to pedestrian walkways, which are almost universally provided in such designs and which would serve to reduce much of the need for streets.

This cluster planning applied to low density community not only preserves valuable woodland and meadow areas, but also is economical in land development for residential use. Parkwood, N.C.? Durham (Fig.43) and Prince George's County, Md.(fig.44) are striking examples of low density communties where cluster planning

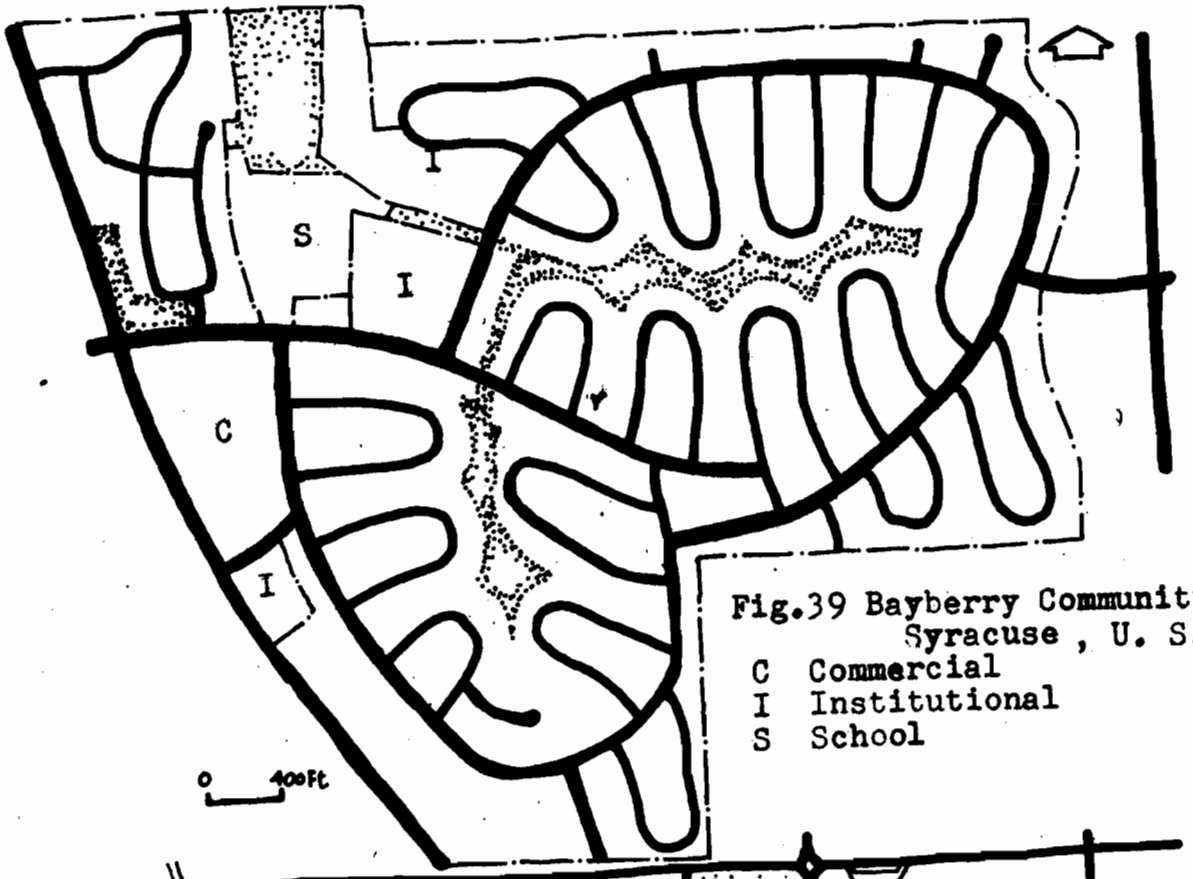


Fig.39 Bayberry Community, Syracuse , U. S. A.
C Commercial
I Institutional
S School

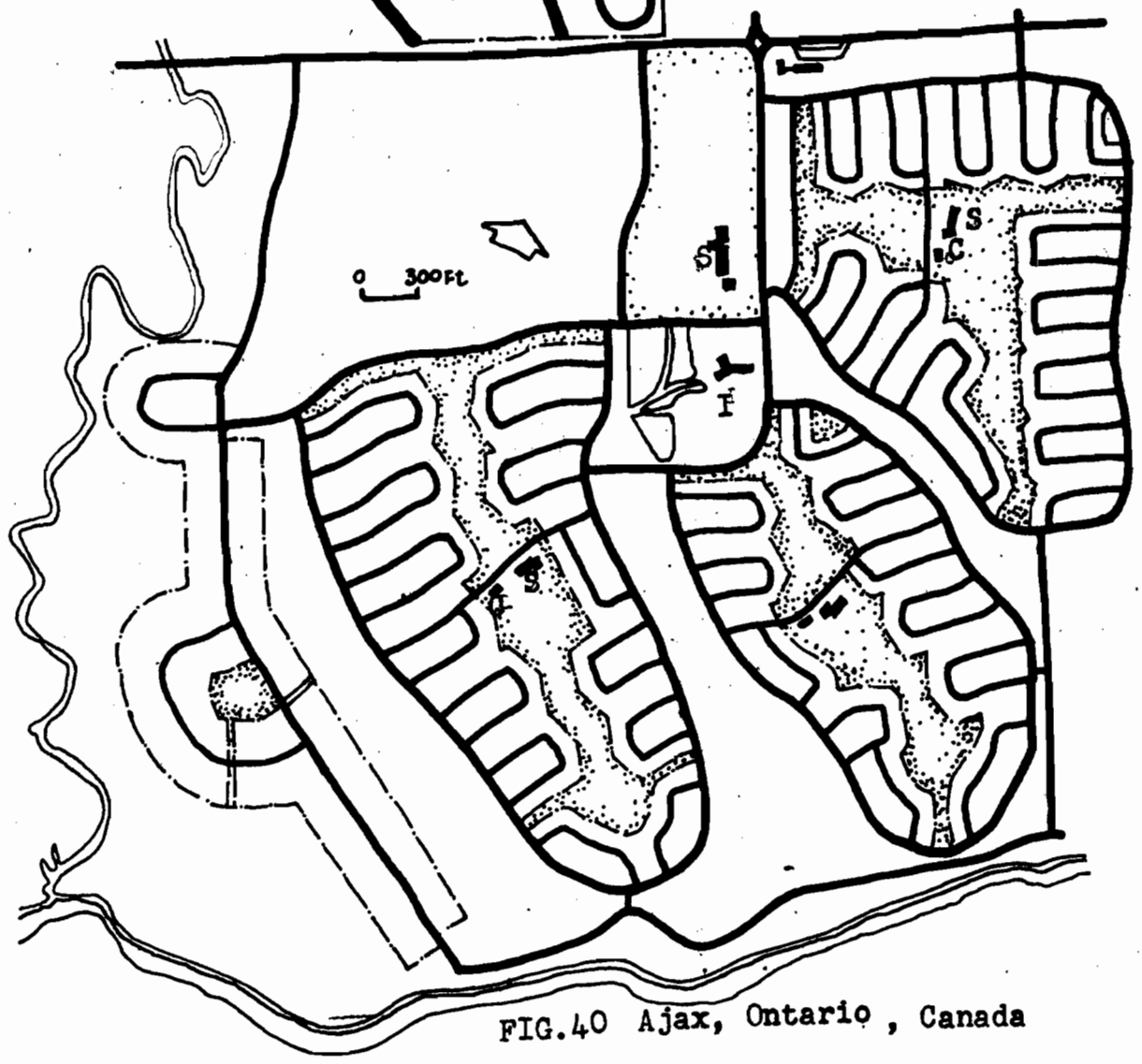


FIG.40 Ajax, Ontario , Canada

Fig. 41 Baronbackarna, Orebro, Sweden

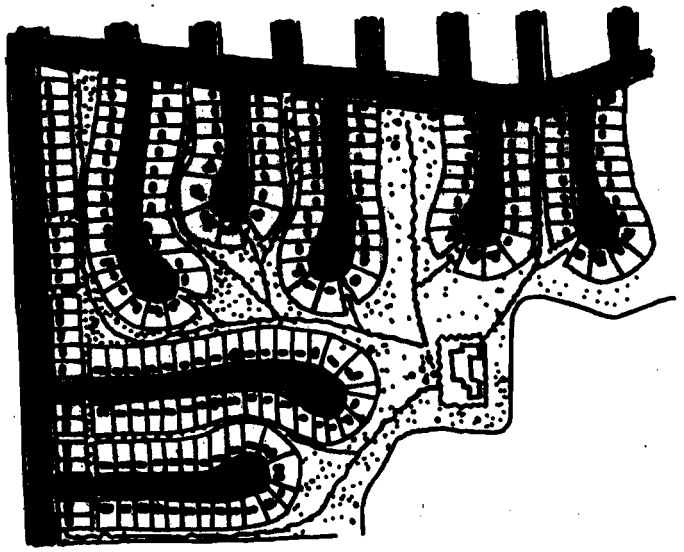
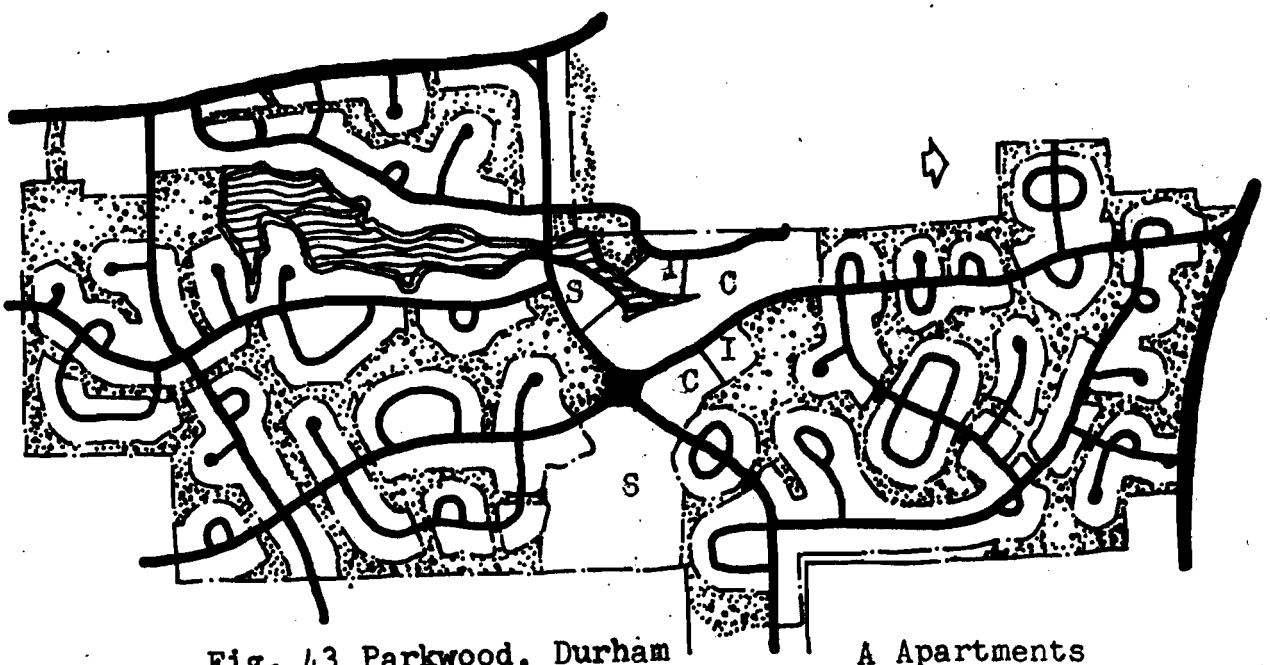


Fig. 42 Cite Jardin, Montreal, Canada



Fig, 43 Parkwood, Durham

0 400 Ft

A Apartments
C Commercial
I Institutional
S School
R Recreational

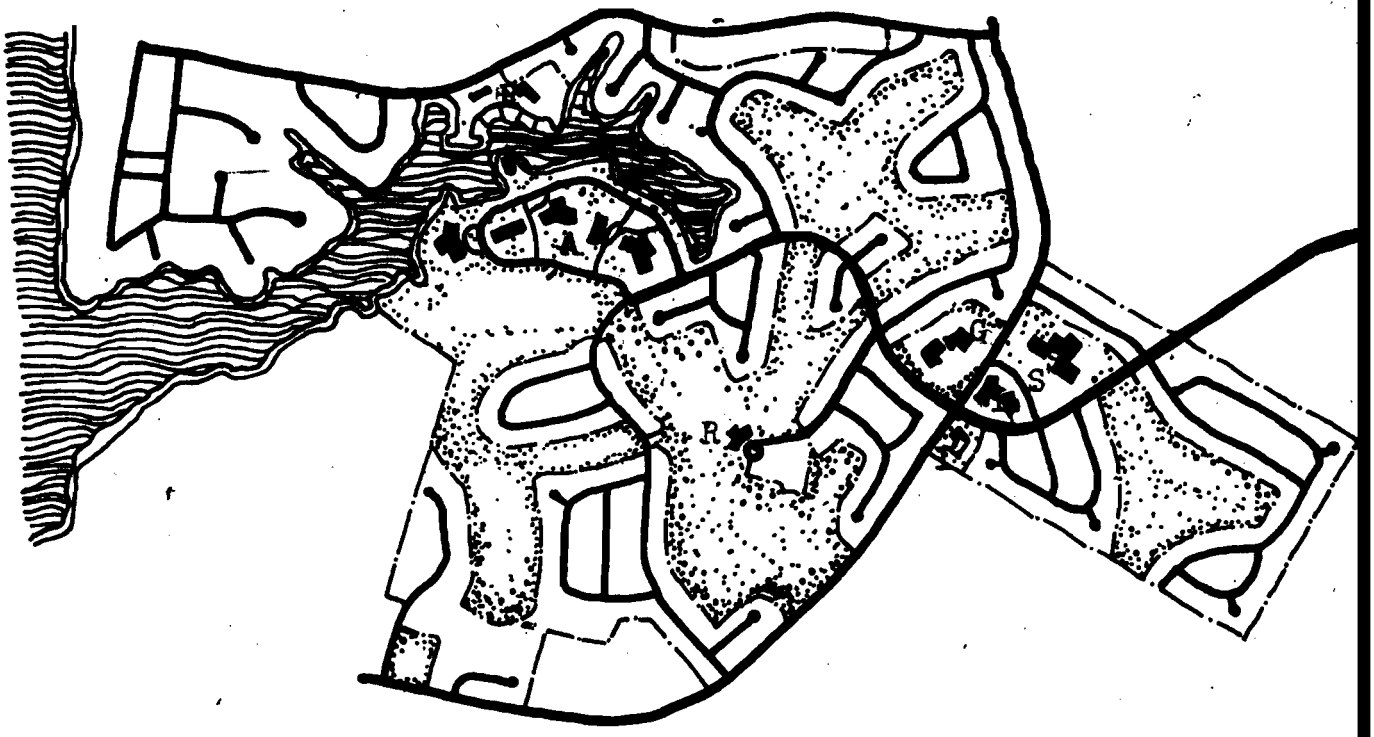


Fig. 44 Prince George's County, Md.

preserves the rural atmosphere of the countryside. The developers obtained shorter streets and utility runs and kept the common areas largely as natural preserves thus reducing maintenance costs.

BY DOMINATING TOPOGRAPHICAL FEATURES

This section contains a brief account of the effect on street pattern of various topographical features. It is, however, understood that topographical condition of the site plays an important role in the disposition of streets.

The exact opposite of formal planning is the layout of streets to achieve harmony with nature by conforming as nearly as possible to the topographical features of the land. By this method individual character is imparted to the scheme by the emphasis of the individual characteristics of the site. From the point of view of economy, no less than from that of convenience and attractive appearance, successful development will depend upon full advantage being taken of all the opportunities which the site itself affords. This is especially true of undulating land, but few sites are quite flat, and there are scarcely any that do not possess some features which influence the design. Hilly sites offer greater opportunities for skillful treatment not only in securing the charm associated with roads winding along the contours or following the natural gradients of the ground, but, by careful adaptation to the levels, in saving considerable expense in the construction of roads and sewers and in the foundations of the houses. In regard to the layout of

streets in a hilly site, C. Tunnard in 1960, wrote in his excellent study, Man-Made America: Chaos or Control? as follows:

> 'Streets should follow ridges and swales; they should not straddle hills perpendicularly to contours, but rather at an oblique angle; they should avoid roller-coaster, broken back, and other discontinuous profiles...'

A curvilinear street plan in Fig. 45 which closely fitted to a rough topography was designed by Community Planning Services, Inc., Pittsburgh. It shows how streets follow ridges and swales, and how contours are crossed at oblique angles.

Other factors controlling the layout of streets on hilly sites are the nature of the surrounding terrace, the best means of access, and the view. On similar locations, with similar topographical features, the street layouts tend to abide by the same pattern in their development as shown in the design of Six Moon Hill near Lexington, Mass. (Fig.46) and Aluminum City in Pennsylvania (Fig.47). They both are located on slopes of a ridge combining wooded areas and have similar layout patterns: a single winding road which leads through most of the project, with the units ranged freely along it in conformity with site contours and views.

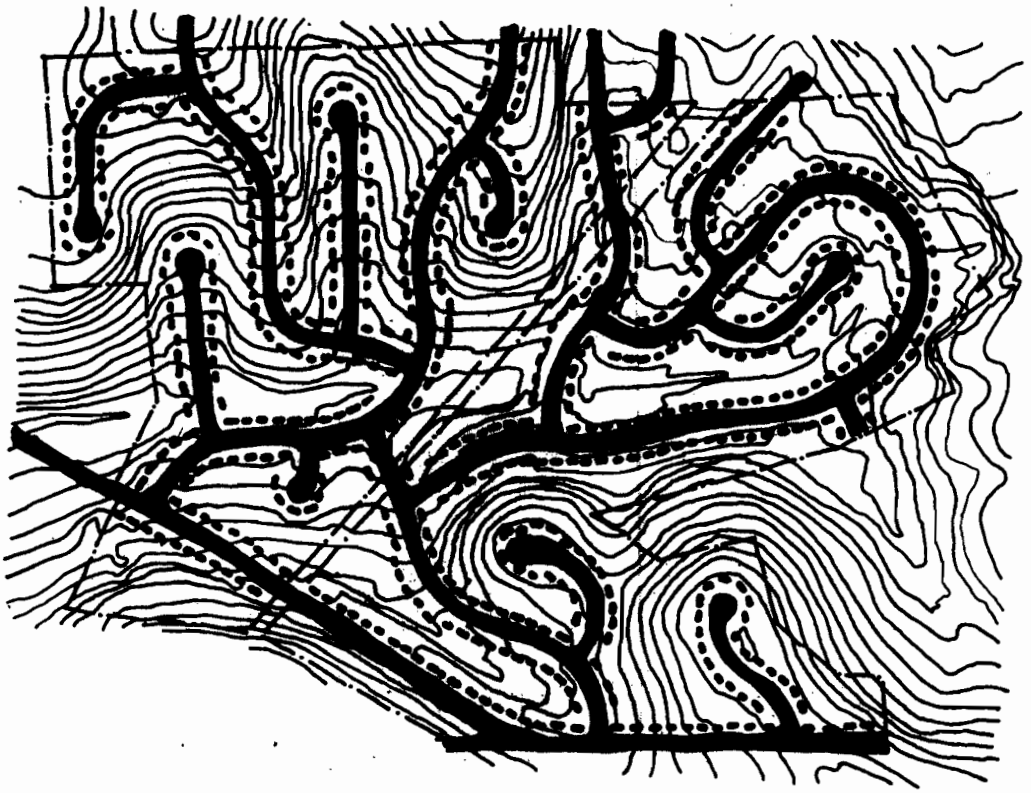


Fig. 45 A curvilinear street plan closely fitted to a rough topography -- design by Community Planning Services, Inc., Pittsburgh.

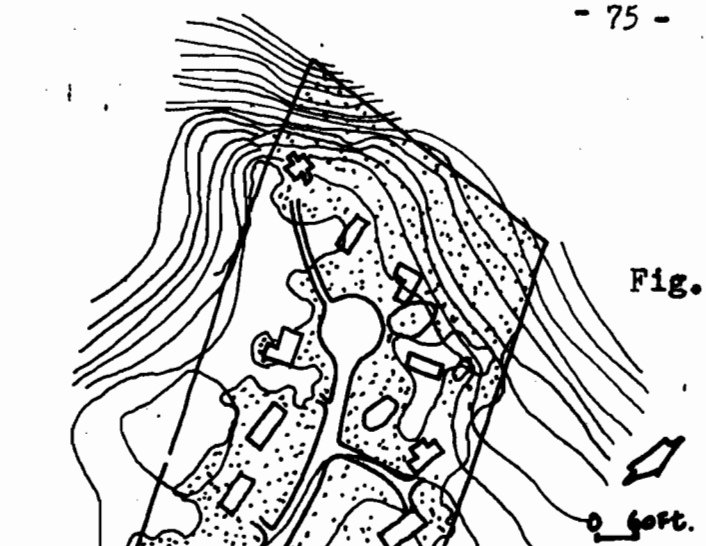


Fig. 46 Six Moon Hill, Mass.

Fig.47 Aluminum City, Pennsylvania

The pattern of streets situated on a hilltop has invariably its focus on the summit with level concentric ring or rings. Sometimes the brow has been left clear, with street and dwellings at a lower level. In earlier periods, defence and power played important roles, but whatever the motivating force, the result of laying out on a hilltop is always a physically distinct community with a characteristic concentric pattern. The loop-road pattern is often applied to hilltops with the highest point left as an open space. The Estate of Lidingo, Stockholm (Fig.48), is composed around a loop-road half-way up the slope. Flat blocks of various types are loosely grouped round the road and, with the trees, encircle the crown of the hill. Another example is the Hilltop Community in Seattle. It is also on a hilltop site with a loop-road layout, which is excellently suited to the topography and has the advantage of the fine views of the countryside from the hilltop. As shown in Fig. 49, the centre is a large park and most of the lots have direct access to the greenbelt which forms a fire break and protective strip around the entire development.

The street patterns in a broad valley are similar to those found in a plain. In case of a narrow valley, all forces turn towards the centre or central axis. As with the hilltop, the valley creates conditions which most easily dictate the unconscious creation of a clear pattern with its focus at the lowest

Fig.48 Lidingo, Stockholm

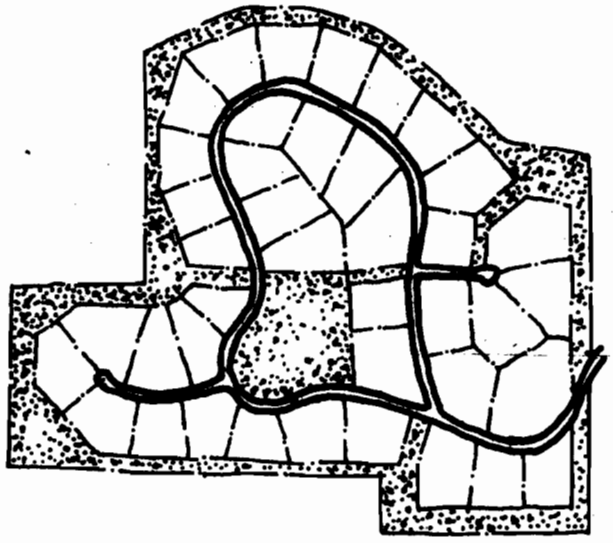


Fig.49 Hilltop Community,Seattle

point of the valley, the reverse pattern of that of the hilltop (Fig.50). Development is linear, and the street pattern is one of narrow movement. This point is well illustrated in Polperro (Fig.51) which is situated in a narrow valley at the head of a small cove on a rocky coast. The houses are cramped and huddled, protected from wind and sea by steep hills on either side, and the streets tumble down in broken lines from the surrounding hills to the harbour's edge.

At a lake site or by the waterside, there is often in addition the sloping ground; the layout patterns are usually adaptations of curvilinear and cul-de-sac or loop principles and are carefully fitted to the unusual topography, as in the development of Lake Waukimis, Kansas City and the Scientist's Cliffs near Washington.

At Lake Waukomis (Fig.52), a lake is preserved as the dominating feature of the whole development. Subdivisions centre around the lake with the abutting lots. In this way, both landscape values and residential values can be maintained in this area.

At Scientist's Cliffs (Fig.53), eight irregularly shaped hills are separated by deep, glen-like ravines which run out to the bay at water level. Each of the eight hills or cliffs is

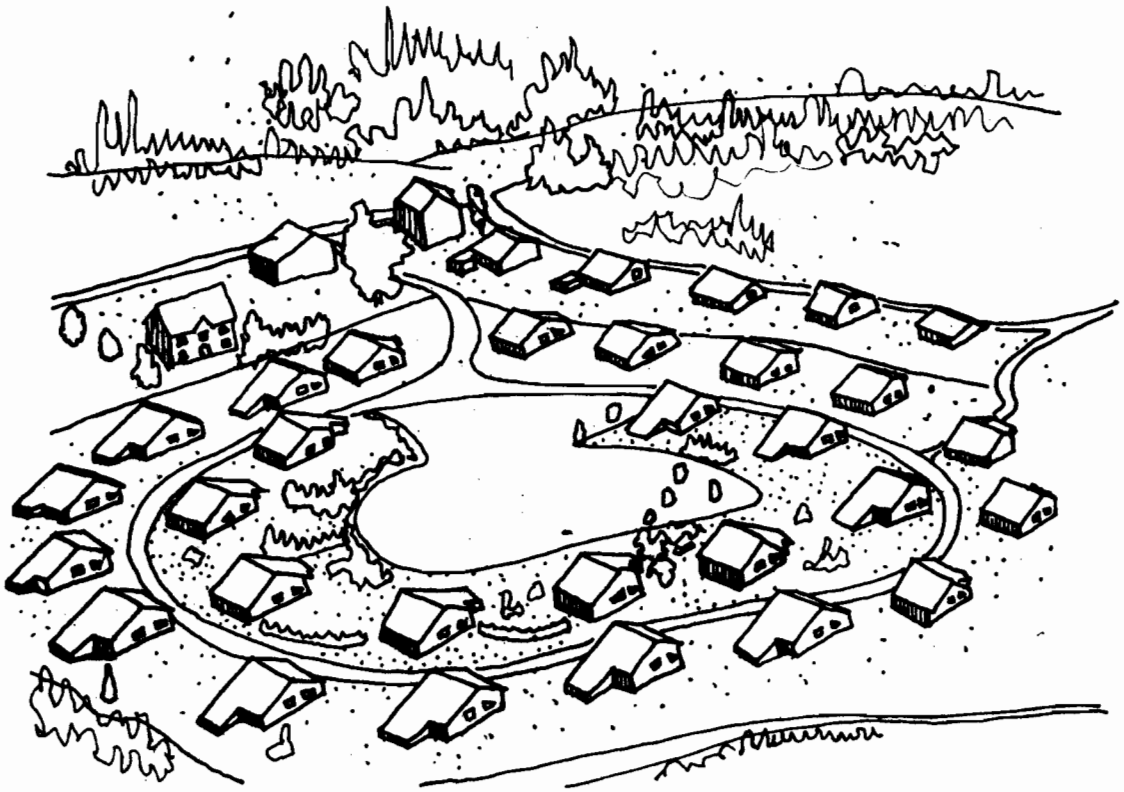
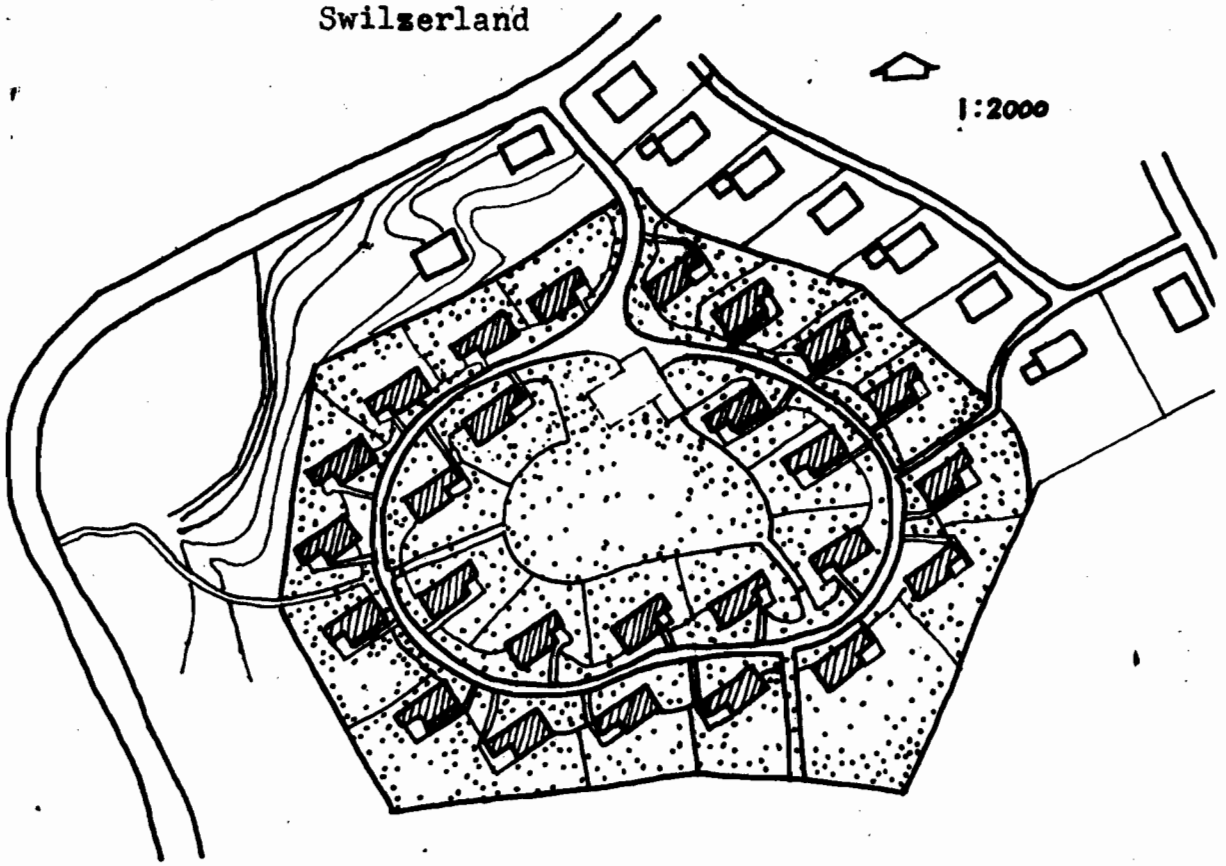


Fig. 50 Brendi Watwil
Swilzerland



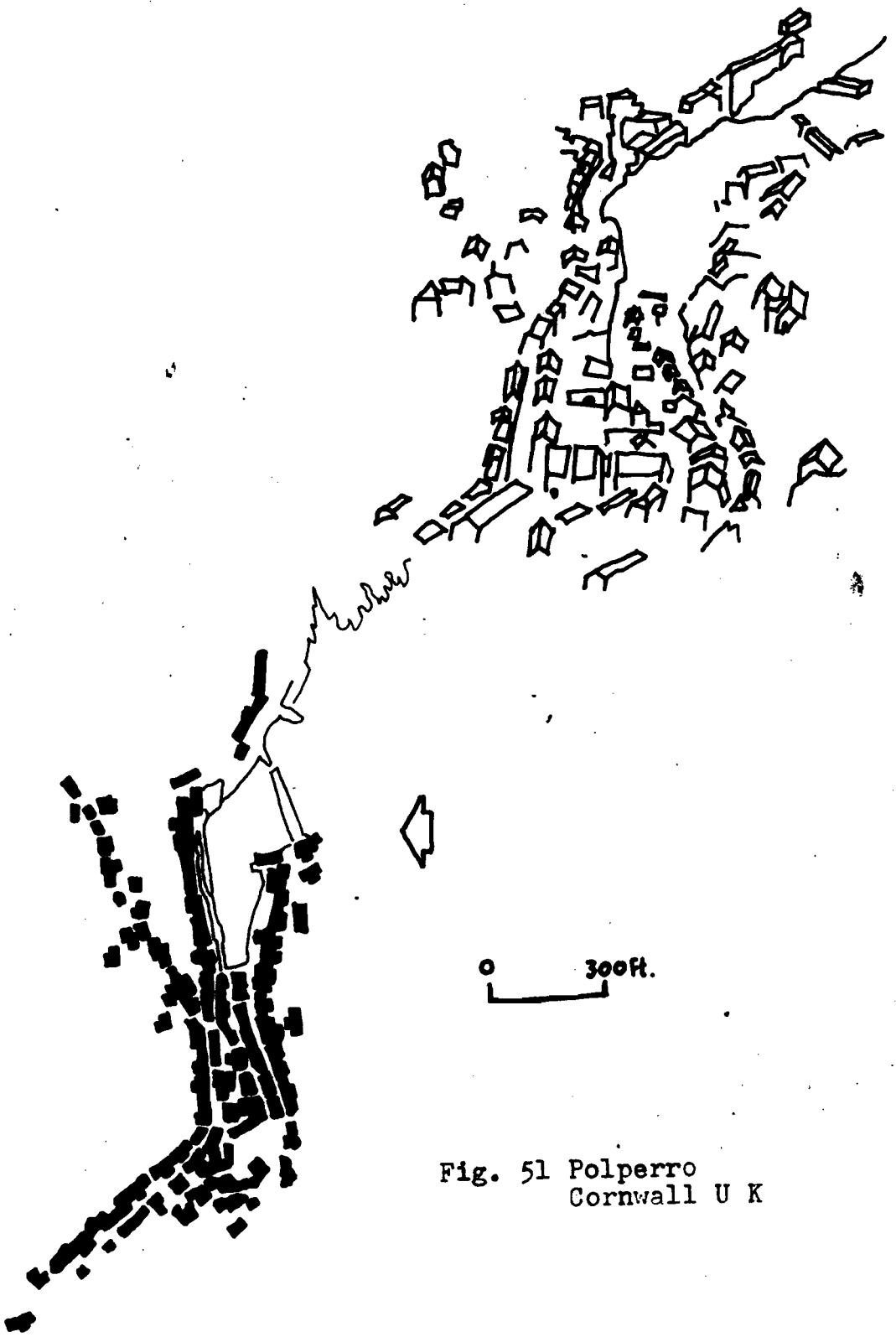
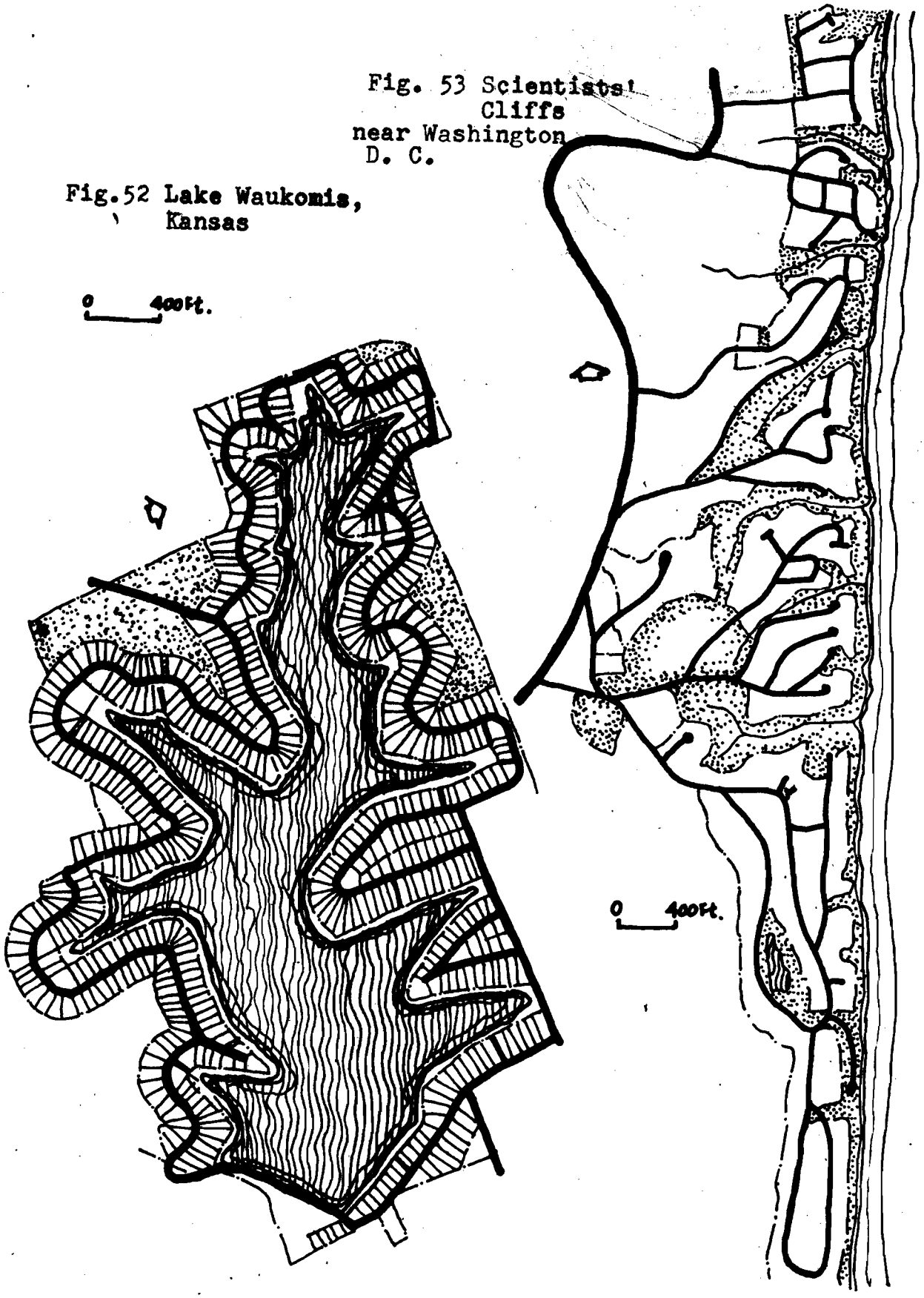


Fig. 51 Polperro
Cornwall U K

Fig. 53 Scientists' Cliffs near Washington D. C.

Fig.52 Lake Waukomis, Kansas



treated as a planning unit, with culs-de-sac or short looped streets in frequent use. Most of the hill units are unconnected, except by walks through the ravines, and by a roadway connection to a set of collector roads on that edge of the development farther removed from the bay front; thus, each planned hill-unit has considerable privacy, and is fully isolated from all through traffic.

It may be seen that the guiding principle in the layout pattern in different topography is that each part must develop according to its own law, that each part must also have its due place, according to its importance and function, within the whole. As St. Augustine said, 'the disposition of equal and unequal things, attributing to each its proper place.'(1)

Flat land offers excellent opportunities for architectural treatment in the formal manner of development in all directions. However, the form which this pattern takes is not subjected to detailed control by topographical factors; and this section only refers to the layout patterns achieved through the dominating topographical features.

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(1) L. Hilberseimer, The Nature of Cities, p. 10, Chicago: Paul Theobald & Co., 1955, p. 133.

PART III STREET PATTERNS AND URBAN GROWTH ON THE ISLAND OF MONTREAL

THE ORIGINAL SETTLEMENT

The early settlement occurred along the river road or 'chemin du Roi' with the main reasons that the soil by the river bank is extremely fertile for agriculture, convenient for access and beneficial due to the unceasing supply of fish. This resulted in a continuous line of houses facing the river. Later, when the water became less important as a means of transportation and the population increased, there was a demand for more land. This brought forth the development of a second road, or 'Chemin du rang'. The linkage between the range road and the river road was made by the lot road. At a later period, came the development of the double-range which resulted from the joining of the 'back bushlands' of the ranges. Because Montreal is an island, it has the characteristics of the river range all around it. The 'chemins du Roi' around the island, Notre Dame Street and Gouin Boulevard used to be the old river roads. Along these roads, the lots are perpendicular to the river. Barkham[1] has outlined this typical development of the range system which is shown in Figure 54.

The Inland of Montreal shows the inland lot system which is characterized by one or more range roads which have access to river road through the lot road. In the Western part of the island, chemin de la Cote Ste. Marie (now Ste. Marie Road) is

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(1) Barkham, B. 'Development of Land Settlement and Rural Architecture in the Province of Quebec' Unpublished. McGill Architecture Thesis, McGill University, 1955.

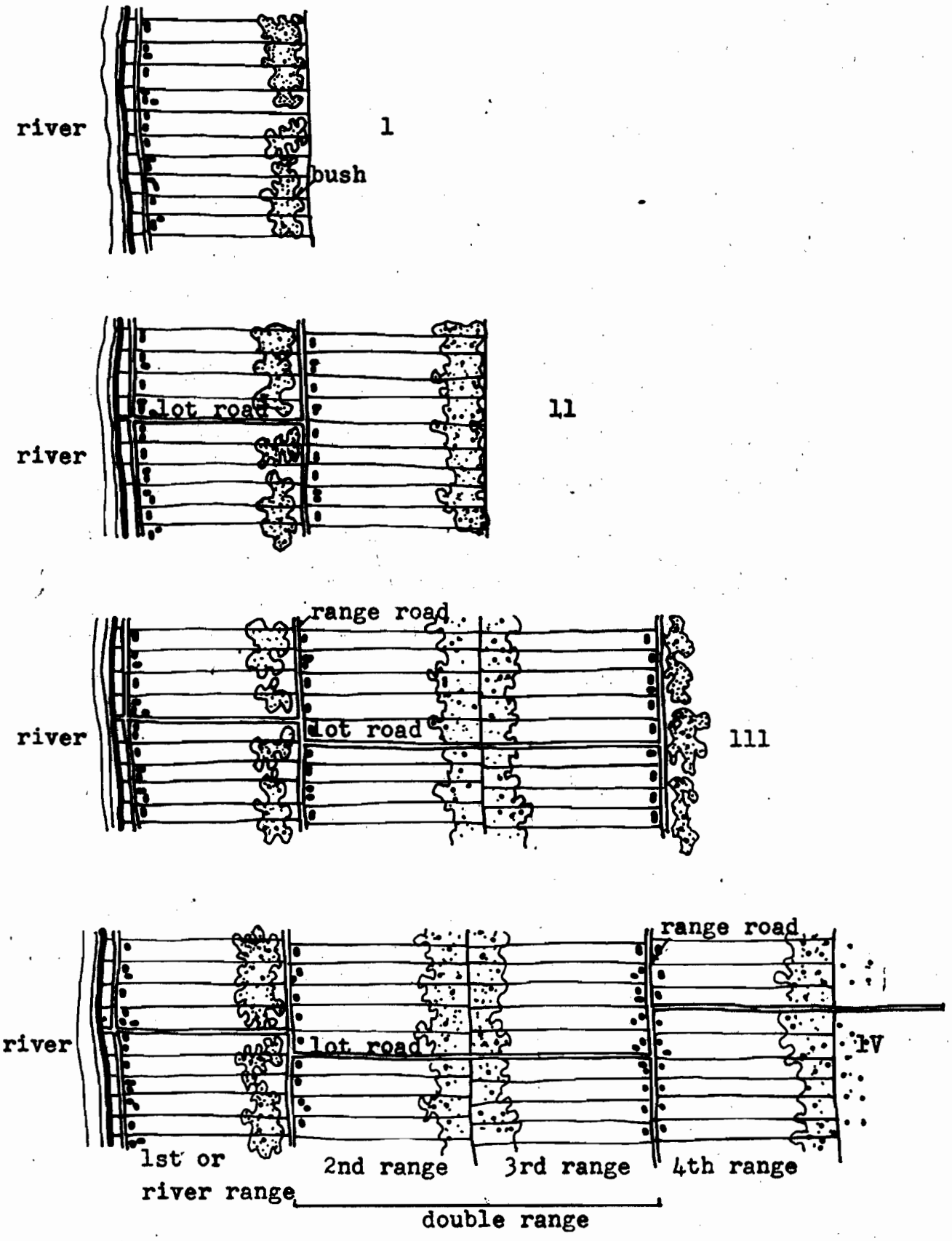

Fig. 54 Development of land settlement

the range road, and the lot road is Montée Ste. Charles which gives access to the river road on both sides of the island.

THE SUBDIVISON OF LONG LOTS

The original system of land subdivision (the long lots) provides the basis for residential growth. The way in which the long lot system has influenced urban expansion may be classified in three general types of subdivision: the unplanned penetration, the planned long lots, and the comprehensive plan for a large number of lots.

The unplanned penetration is the most common form of residential extension. There are differences between the river front and the inland lot systems. In the first case, growth occurs from an expansion in housing, along the lot roads. The nucleus is at the junction of the lot road and the river road. Later growth comes in the form of 'fingers' of urban use infiltrating into the rural countryside. The process of this development is shown in Figure 55, and an example of this is found at Rivière des Prairies (Fig.56). In this case there has been no attempt to subdivide the long lots for future joining of the developed fingers. The general form of development is an elongated grid with the access roads leading to the 'chemin'. The non-developed land between the houses may still be farmed or laid idle. The rigid framework of the lots has greatly influenced this kind of development.

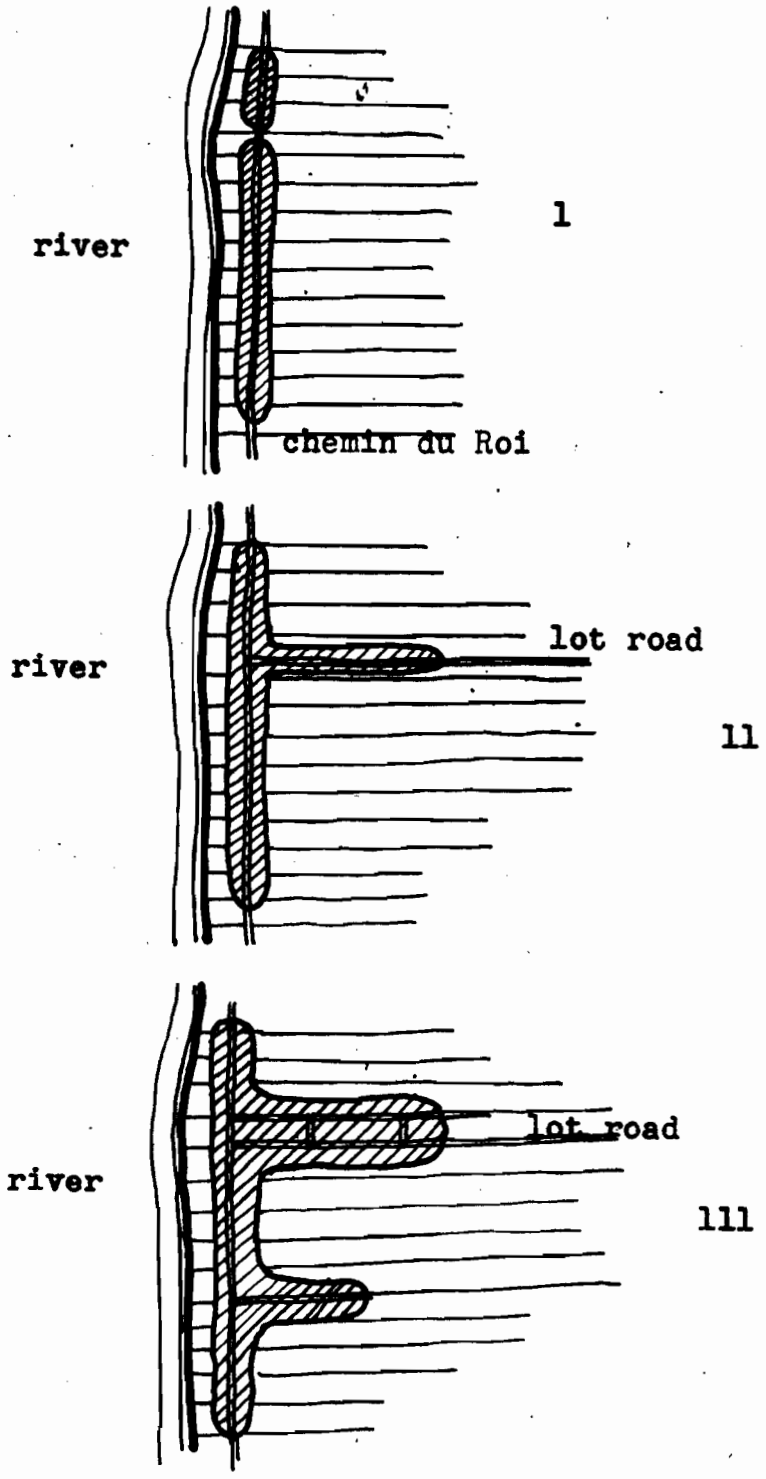

Fig.55 Development of urban use in a river range

Fig. 56 Unplanned penetration - Rivière des Prairies

In the case of the inland lot system, variations come from the initial nucleus of development. When the nucleus is at the junction of the range road and the lot road, the development may take any direction as shown in Figure 57 where five possibilities of this development exist. The urban area is fragmented and there are agricultural lots between them and there is no trace of planning. So, in the case of non-planned land subdivision of long lot, development occurs by penetrating into farm land bit by bit, which brings about the inevitable gridiron street pattern.

The planned long lots differ from the unplanned ones in their streets vary in design, they escape from prevailing gridiron layout and are patterned differently from their surroundings. This result is achieved with the aim at providing a better residential environment. In planned long lots, the difficulty is in designing a small number of lots which reduce the potential effectiveness of the planned subdivision, and one finds this potentiality only in the larger comprehensive plans. Since all the land is not available to only one developer, there are differences in the layout of street patterns in the adjoining areas. Examples of planned long lots will be presented in the subsequent sections.

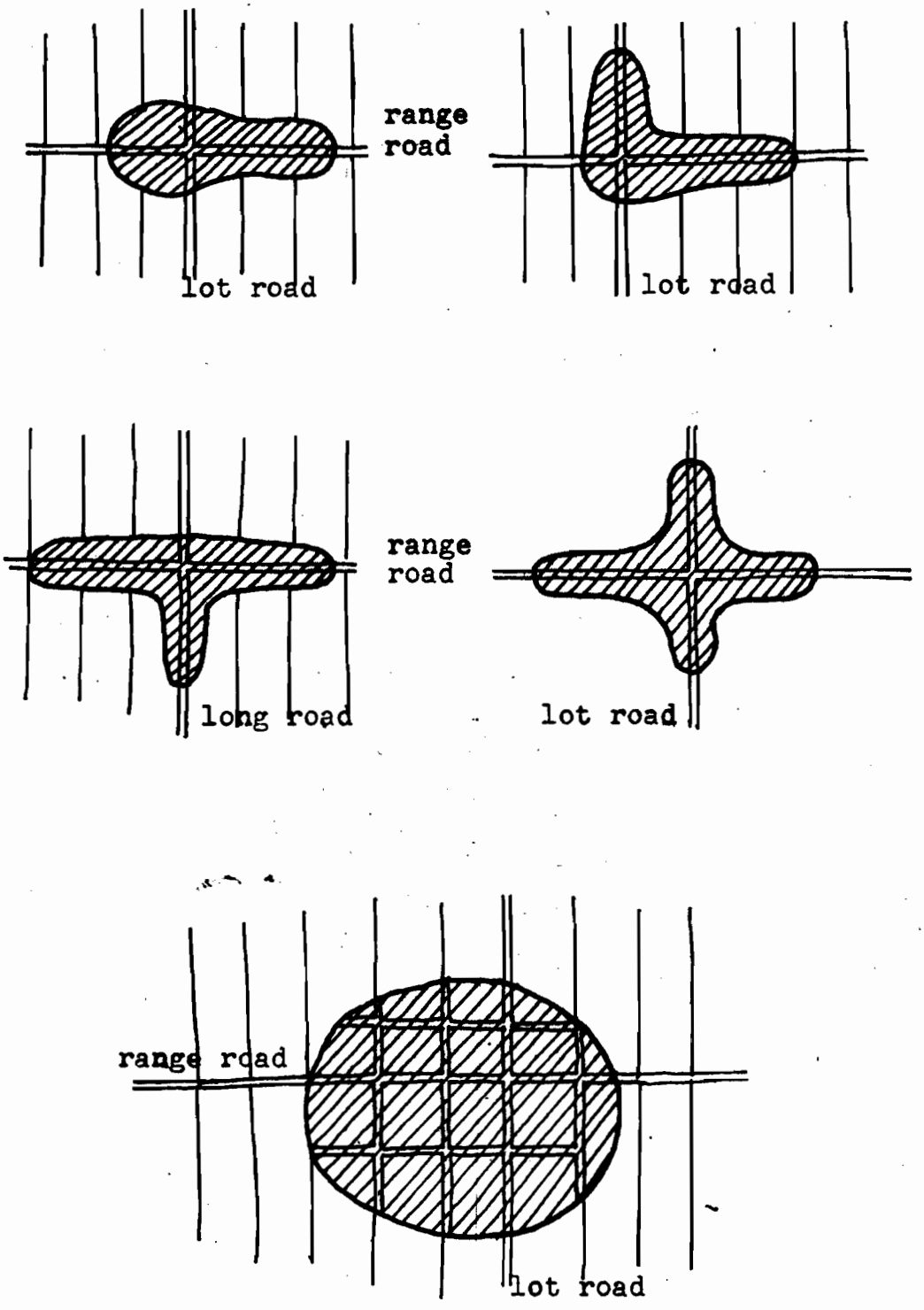

Fig.57 Types of urban nucleus in the inland ranges

Fig. 58 Early development of inland lot system

The comprehensive plan involves a larger number of lots than other types of subdivision. It designs for the layout of the whole area. Therefore, it can be a greater concern for a complete master plan of the whole development area. All developments within the municipality have to correspond to the master plan and zoning regulations. Provision includes a complete system of roads, the lines of drainage, the division of the land into individual plots and the arrangement of houses thereon; and the reservation of such sites as may be needed for open spaces, shops, schools, and other buildings of public or semi-public character. In the case of a very large scheme, especially where in the nature of self-contained suburbs or small towns, it may be necessary to consider the allocation of land for industrial purposes. Therefore in the comprehensive plan, a large unit area of land has to be available, and in this way it differs from the planned long lot.

On the Island of Montreal, there are only two areas that can be classified as having comprehensive plans. They are the town of Mount Royal and the Ville d'Anjou. The Town of Mount Royal was designed by F.G. Todd and was incorporated in 1912. This residential area was originally purchased by the Great Northern Railway. The town plan (Fig. 59) was laid out in a formal symmetrical pattern with diagonal boulevards leading to

Fig. 59 Town of Mount Royal

the town centre, and the basic street pattern was that of a parallel grid layout. Ville d'Anjou (Fig.60) had a different development. Before incorporation in 1956, it was mainly a farming area with 750 inhabitants. Some 'unplanned penetration' had started in the eastern part, but this was not the major development. An area of about 300 acres which was taken up in 1959 was designed by C.E. Campeau with its main traffic routes on the periphery instead of penetrating through the residential areas. Within the town, a convenient street pattern was built according to the requirements of the traffic volume.

In this section, three distinct types of land subdivision namely, the 'unplanned penetration', the 'planned long lots', and the 'comprehensive plan' have been described. These three types of land subdivision have dominated in the pattern of urban growth on the Island of Montreal.

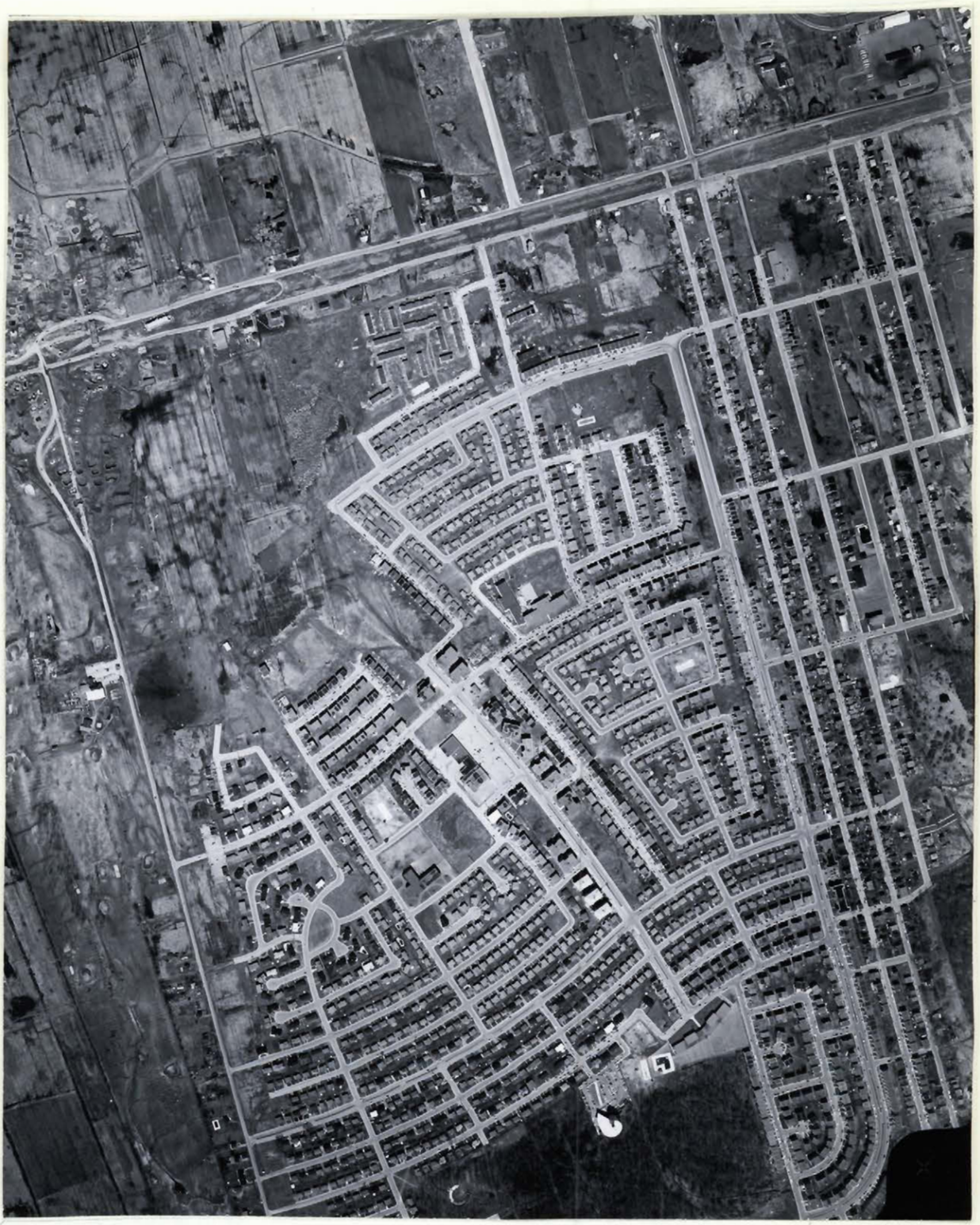

Fig. 60 Ville d'Anjou

DEVELOPMENT OF STREET PATTERNS

UP TO 1932, 1932 - 1952, 1952 - 1961

A full review of the development of the patterns of streets on the Island of Montreal requires a volume to itself. For the purpose of this section, a brief resume of the changes in design and layout will suffice. The entire period can conveniently be divided into three parts: up to 1932, 1932 - 1952, 1952 - 1961. Each of these periods is characterized by a different pattern of urban growth and street layout.

An analysis of the urban growth on the island of Montreal is given in a recent study by the City Planning Department[1] and in a thesis by Khor[2]; from these two studies Tables 1 and 2 on the following pages have been derived. The entire analysis is based on regional division of the Island (Central Area - 11 municipalities, Western Section-19 municipalities, and Eastern Section - 6 municipalities), proposed by the City Planning Department of Montreal. Maps[3] have been drawn to illustrate the extent of the urbanized areas during the periods of 1932, 1952, and 1961. (Fig. 61, 64, 68)

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(1) City Planning Department, The Rate of Urban Development, 1952-1961, Bulletin Technique No. 4, Unpublished, March 1964.

(2) Khor, Ean-Lay, Evolution of Land Subdivision, Montreal: McGill University Thesis, 1964.

(3) Series of Three Maps: Land Used for Urban Purposes--1932, 1952, and 1961, Montreal: City Planning Department, Nov. 1962.

TABLE I: Urbanized Land in 1932, 1952, 1961 (Acres)

	Island of Montreal			Central			West			East		
1. Total Area	121,700			42,700			56,000			23,000		
% of Area	100.0			35.1			46.0			18.9		
2.	1932	1952	1961	1932	1952	1961	1932	1952	1961	1932	1952	1961
Developed Land	29,586	44,800	66,000	23,061	30,800	37,400	5,098	9,600	21,300	1,427	4,400	7,300
% Total Area	24.3	36.8	54.3	54.0	72.0	87.6	9.1	17.1	38.0	6.2	19.2	32.0
% Total Developed Land Area	100.0	100.0	100.0	77.9	68.7	56.7	17.2	21.4	32.2	4.9	9.9	11.1
3. Planned Long Lots	327.6	1,275.8	5,858.7	0.0	579.8	985.7	327.6	696.0	4,578.5	0.0	0.0	294.5
% Developed Land Area	1.1	2.8	8.9	0.0	1.9	2.6	6.4	7.3	21.5	0.0	0.0	4.0
4. Comprehensive Planned Area	390.1	800.0	1,592.0	390.1	800.0	1,292.0	0.0	0.0	0.0	0.0	0.0	300.0
% Developed Land Area	1.3	1.8	2.4	1.7	2.6	3.5	0.0	0.0	0.0	0.0	0.0	4.1
5. Total Planned Area	717.7	2,075.8	7,450.7	390.1	1,379.8	2,277.7	327.6	696.0	4,578.5	0.0	0.0	594.5
% Total Developed Land Area	2.4	4.6	11.3	1.7	4.5	6.1	6.4	7.3	21.5	0.0	0.0	8.1

TABLE 2: Changes in Urbanized Area 1932 - 1952, 1952 - 1961 (Acres)

	Island of Montreal		Central		West		East	
	1932-1952	1952-1961	1932-1952	1952-1961	1932-1952	1952-1961	1932-1952	1952-1961
1. Developed Land	15,214	21,200	7,739	6,600	4,502	11,700	2,973	2,900
% Change	51.4	47.3	33.6	21.4	88.3	121.9	208.3	65.9
2. Planned Long Lot	948.2	4,582.9	579.8	405.9	368.4	3,882.5	0.0	294.5
% Change	289.4	359.2	--	70.0	112.5	557.8	0.0	--
% Developed Land Change Due to Planned Long Lots	6.2	21.6	7.5	6.2	8.2	33.2	0.0	10.2
3. Comprehensive Planned Area	409.9	792.0	409.9	492.0	0.0	0.0	0.0	300.0
% Change	105.1	99.0	105.1	61.5	0.0	0.0	0.0	--
% Developed Land Change Due to Comprehensive Plans	2.7	3.7	5.3	7.5	0.0	0.0	0.0	10.3
4. Unplanned Lots	13,855.9	15,825.1	6,749.3	5,702.1	4,133.6	7,817.5	2,973	2,305.5
% Developed Land Change Due to Un-Planned Lots	91.1	74.7	87.2	86.3	91.8	66.8	100.0	79.5
5. Planned Area	1,58.1	5,374.9	989.7	897.9	368.4	3,882.5	0.0	594.5
% Change	394.5	485.2	105.1	131.5	112.5	557.8	0.0	--
% Developed Land Change Due to Plan-Area	8.9	25.3	13.8	13.7	8.2	33.2	0.0	20.5

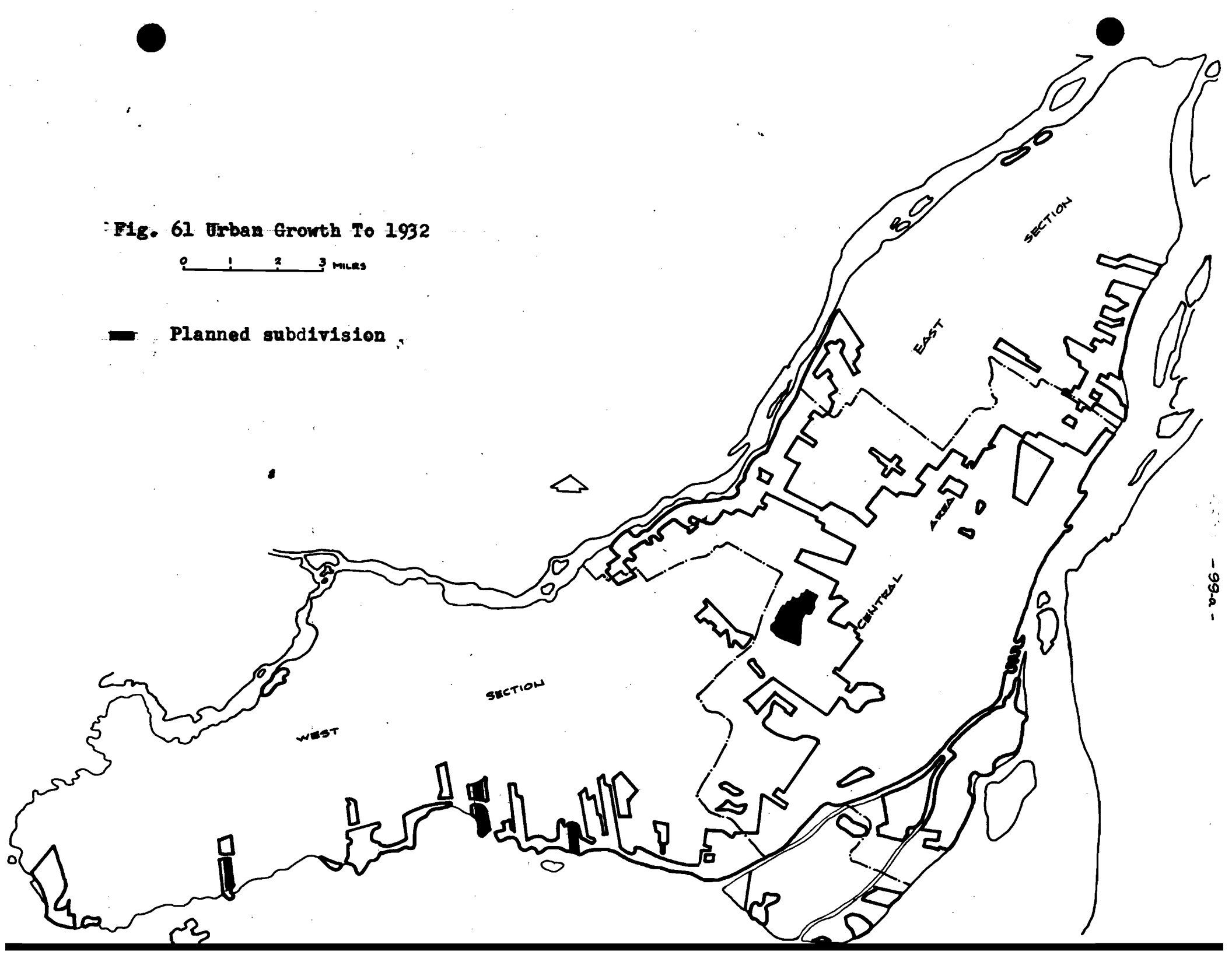
Development up to 1932

In 1932, the most urbanized area is the nucleus of the present metropolitan region of the City of Montreal. Three basic patterns (Fig. 61) for the urbanized land emerge from this highly developed area:

1. There is a line stretching from the nucleus to the Western Section along the old 'chemin du Roi' bordering Lac St. Louis. The development is rather scattered with some penetration inland.
2. The second line extends from the nucleus to the Eastern Section. It follows the old Chemin Hochelaga. In this direction, the extent of urban development is smaller than that in the Western Section, but both have the same basic characteristics.
3. The third pattern is in the northern part of the Island along Rivière des Prairies and its old 'chemin'. The centre of this development is at the junction of the chemin and the lot road, Montée St. Laurent. It spreads out east and west, but does not penetrate much inland.

Most of the land on the eastern and western parts of the Island of Montreal is unurbanized. The development has followed lines established by the original cadastral divisions. So that

Fig. 61 Urban Growth To 1932



apart from the city proper, the patterns of urbanized land on the Island of Montreal are lines along the 'chemins' with some linkages at the lot roads. According to the data presented in Table 1, the Central Area has 35% of the total land area on the Island. The West has 46% and the East has 19% of the total. In 1932, almost 78% of the total developed land area was in the Central Area, while 17% in the West and 5% in the East. In this period, only 24% of the total land area had been developed for urban purposes which covered over one half of the land in the Central Area. With regard to the planned areas on the Island, in 1932, only 2.4% of the total developed land was planned. According to Table 1, the largest planned area was in the West, equal to 6.4% of its total developed land. The majority of residential development in 1932 that were not planned resulted from speculative penetration into the long lots. These unplanned penetration areas have similar characteristics; the streets being arranged to comply with a rigid 'gridiron' layout pattern, with little regard either for natural features and orientation or for varying traffic load demands. Further, there was also lack of focus, essential planlessness, and dreariness which resulted in the fragmented and irregular nature of development. The planned subdivisions were more important although they occupied only a small part in the total developed land. They were designed to depart from the prevailing 'gridiron' layout.

Figure 62 shows the three planned long lots built in 1932 and their locations are shown in Figure 61. These planned long lots show some variation in the street pattern with cul-de-sac type of short streets in Beaconsfield, (Fig. 62-a), curve roads and crescents arranged in diamond-shaped enclosures in Dorval (Fig. 62-b), and the combination of curve and circular roads also in Dorval (Fig. 62-c). They reflect a desire on the part of the developer to create a more pleasant living environment. The comprehensive plan of the Town of Mount Royal, at its early stage of development (Fig. 63), illustrates a basic 'gridiron' pattern adjusted by the imposition of four diagonal roads.

Thus in 1932, planned subdivisions, although limited in extent, began to take place in Montreal. The Town of Mount Royal comprehensive plan was very important because it set an example for future planned subdivisions.

(a) Beaconsfield

(b) Dorval

(c) Dorval

Fig. 62 Planned long lots in 1932

Fig. 63 Town of Mount Royal- early stage of development

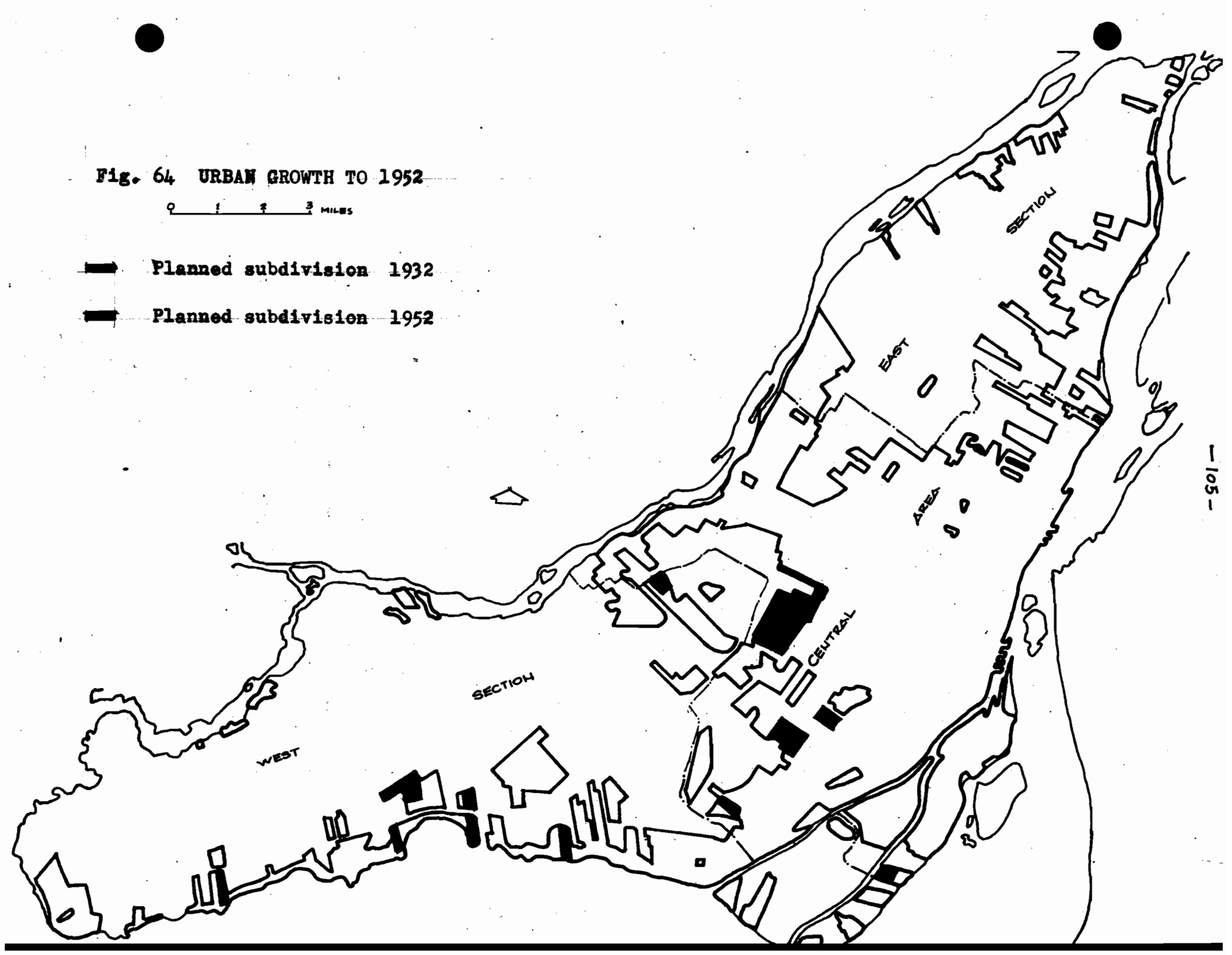
Development Between 1932 and 1952

From 1932 to 1952, urbanized land increased by one half on the whole Island. In this period, the three basic elements of the development were still noticeable as shown in figure 64.

In the Western Section, the settlement became almost continuous along the Lakeshore Chemin. Inland penetration was still dominant. But a gradual filling-up was noticeable when approaching the centre. The line of urbanized land in the Eastern Section became completely linked to the nucleus. Penetration inland was more significant here than in the Western Section of the Island. The Northern development had penetrated more inland, but it did not extend as much to the East and West. Although there had been some developments at Roxboro and Pierrefonds, and at Riviere des Prairies, they remained fragmented and did not link with the nucleus of the northern urbanized area. This nucleus was situated at the junction of the Chemin and Montée St. Laurent which was the link between the Northern development and the Central nucleus. The Central Area expanded to reach the three main lines of development. It was still the most powerful force of urban growth.

According to the data presented in Table 1, 37% of the total area of the Island of Montreal became urbanized by 1952. The

Fig. 64 URBAN GROWTH TO 1952



Central Area had 68.7% of the developed land in comparison with 21.4% in the West and 9.9% in the East. As for planned areas, only 4.6% (2.6% in 1932) of the total developed area of the whole Island was planned.

The results of the changes in urbanized land from 1932 to 1952 are shown in Table 2. The urbanized land of the Central Area increased by 33.6% of which 12.8% were planned subdivisions. The comprehensively planned Town of Mount Royal doubled in extent. In these central developed areas, over 87% of the total increase in developed land was due to unplanned penetration. The Eastern Section had the largest growth in urbanized land with an increase of some 208% during those twenty years, but all this increase was 'unplanned penetration'. In the Western Section, almost 92% of the total increase in developed area was due to unplanned penetration. For the Island as a whole, 91.1% of the increase in urbanized land from 1932 to 1952 was due to unplanned penetration. Planned long lots increased by some 289%, but their relative importance to the total increased urbanized land was only in the order of 6.2%.

The patterns of streets in the planned long lots in this period are shown in Fig.65, 66, 67, with their respective locations as indicated in figure 64. The Radburn idea has been

(a) Crawford Park, Verdun

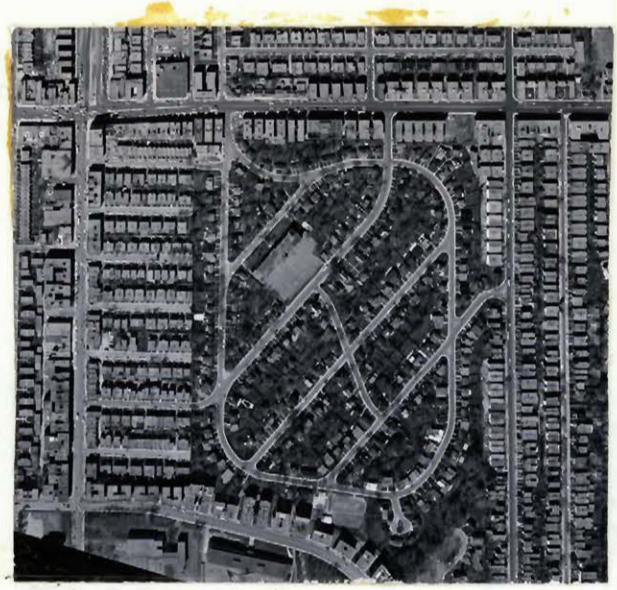
(b) Cite Jardin

Fig. 65 Planned long lots in 1952

tried out in two areas: Crawford Park in Verdun (Fig.65-a) and Cite Jardin in Montreal (Fig. 65-b). In these areas, houses have been arranged in groups fronting on culs-de-dac with internal common open space. Of the two examples, City Jardin, designed by J. Auguste Gosselin and R.P. Jean d'Autewil Richard, probably succeeds to a greater extent in attempting to develop the Radburn idea. There are seven culs-de-sac (in comparison to 3 culs-de-sac in Crawford park) and enough common area to allow an attractive arrangement of recreation sites throughout the development. The path system is in no way ever regarded as being dangerous. Crawford Park and City Jardin are two examples on the Island of Montreal, of an attempt to base development on certain planning theories -- the separation of vehicular and pedestrian traffic according to the Radburn idea.

Another example with cul-de-sac layout is found in Pointe-Claire (Fig. 67-a). It is planned to build houses for veterans. The street plan is very open. It is the combination of crescent and cul-de-sac streets in order to discourage through traffic penetration into this residential area.

There are three planned long lots with curved grid type of street pattern in Hampstead, Ville St. Laurent and the City of Montreal. These are represented in Figure 66. The winding



(a) Montreal

(b) Hampstead

(c) St. Laurent

Fig. 6 6 Planned long lots in 1952

streets in these patterns provide greater opportunity for a pleasing environment with different vistas, and a flexibility in the siting of houses within the plan. Other types of street pattern are the enclosure layout (Fig. 67-c), the blocked grids (Fig. 67-b), and the combination of both (Fig. 67-d). All these examples are the result of a conscious desire to achieve more safety and privacy in the residential area.

(a) Pointe Claire

(b) Pointe Claire

(b) Pointe Claire

(d) Cote St. Luc, Montreal West

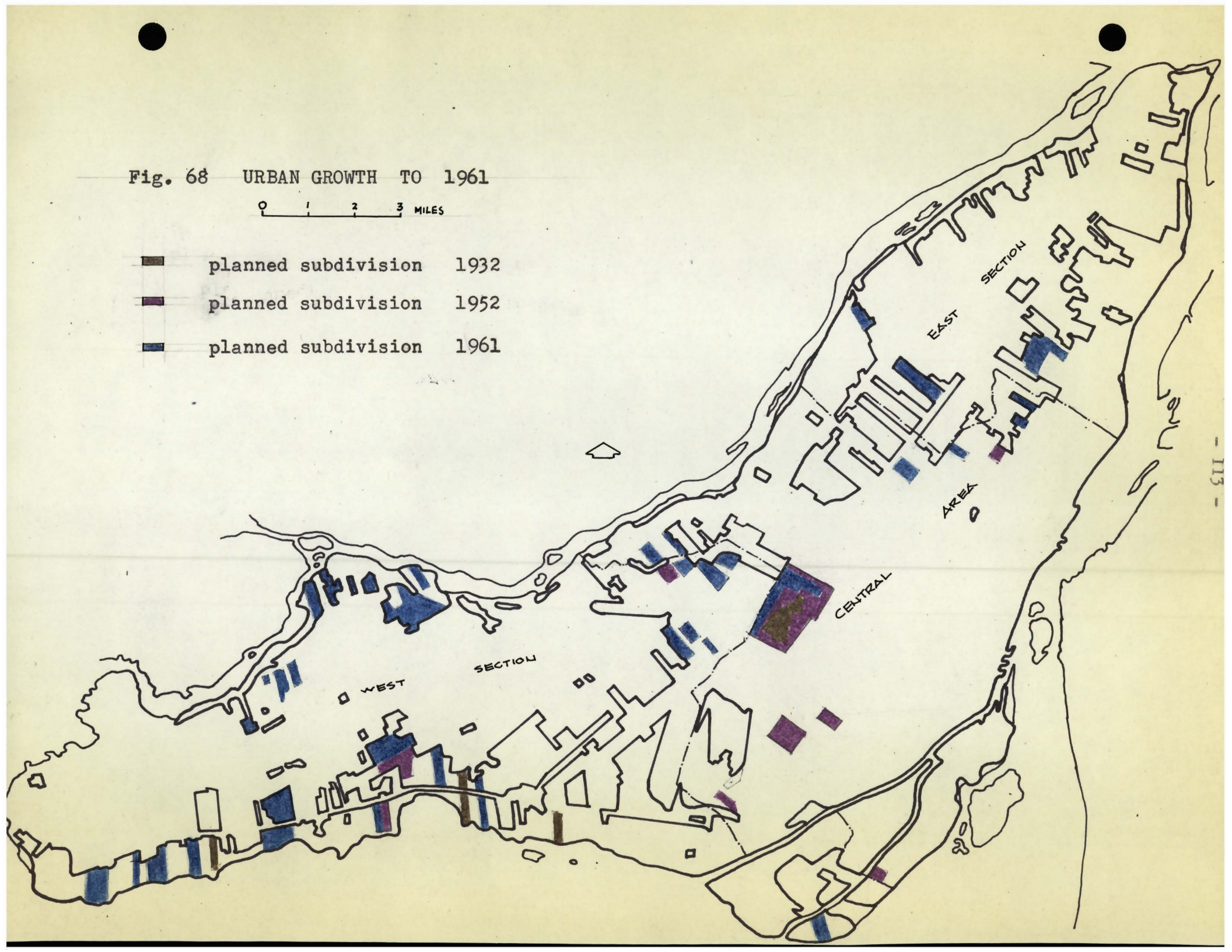
Fig. 67 Planned long lots in 1952

Development Between 1952 and 1961

From 1952 to 1961, the urbanized land again increased by one half so that by 1961, over 54% of the Island was used for urban purposes and the resulting pattern is shown in figure 68.

The western development reached Ste. Ann de Bellevue along the old chemin. The filling had been mainly lineal with some inland penetration. The greatest degree of inland penetration was at Pointe Claire. This was due to the existence of the Industrial Park and to the Trans-Canada Highway. Dorval and Lachine, as well as most of LaSalle, had become joined to the main body of urbanized land extending from the nucleus. The Eastern Section of the Island had more unplanned penetration than the West. The extension of urbanized land in the Eastern chemin proceeded rapidly, and again the amount of filling increased nearer to the nucleus. The northern development of the Island became extended to the West and East. To the West, the line of urbanized land stretched along the chemin facing Rivière des Prairies. There were large developments there, such as Roxboro, Pierrefonds and Dollard des Ormeaux. To the East, the line of urban development was also nearly continuous, but it involved more inland penetration. There were increased

Fig. 68 URBAN GROWTH TO 1961



numbers of links between the Northern chemin area and the nucleus. This was the result of the rapid growth of Cite de St. Laurent, St. Michel and Montreal Nord. The central nucleus itself had expanded so rapidly that an area such as the Town of Mount Royal, which could still look northward to undeveloped land in 1952, became almost completely surrounded by the urbanized area.

According to the data presented in Table 1, by 1961, the Central Area had 56% of the total urbanized land and the West possessed more than 32%. The planned areas covered 11% of the total built-up land on the Island. 6% of the Central Area urbanized land was planned, 8% in the East and more than 21% in the West. The change from 1952 to 1961 can be seen in Table 2. The greatest rate of urban growth was in the West with 121.9%, in comparison to 65.9% in the East, and only 21% in the Central Area which was mainly due to the lack of available land in this area. The planned long lots on the Island increased over 359%; while in the West, this increase reached almost 558%. Taken as a whole the proportion of the increase in urbanized area due to planned subdivision, was 25.3% as compared to 8.9% in the previous twenty years. The proportion of urban growth due to unplanned penetration had become greater in the Central Area in 1961, with 86%, in comparison with 6.7% in the West and 80% in

the East. In the previous period, the Central Area had been the area least affected by unplanned accretion.

The Town of Mount Royal was completed and another comprehensive plan, Ville d'Anjou was created in the Eastern Section. But this comprehensive plan was still lacking in the Western Section. Many planned long lots were large enough to be included in a comprehensive plan; but this was hindered in its development by land held in speculation. Even so, some planned long lots became the complete parts of a larger master plan. Examples of this on the Island of Montreal were part of Cite de St. Leonard, part of Cite de La Salle, and parts of Pierrefonds and Dollard-des-Ormeaux. The proposed street plan for St. Leonard was shown on many recent maps, parts of the subdivisions north of the Trans-Canada Highway had been completed by 1961. Its street plan is presented in figure 69 in which all streets that 'lead nowhere' would eventually be tied into the overall master plan. Similarly, in Cite de La Salle, the street plan (Fig. 70) was also an incomplete one. A comprehensive master plan for Pierrefonds and Dollard-des-Ormeaux also existed (Fig. 71) and the developments in 1961 were similar in their spread to that in St. Leonard and La Salle. The street plan was obviously meant to link up with others, when the intervening areas were opened for development.

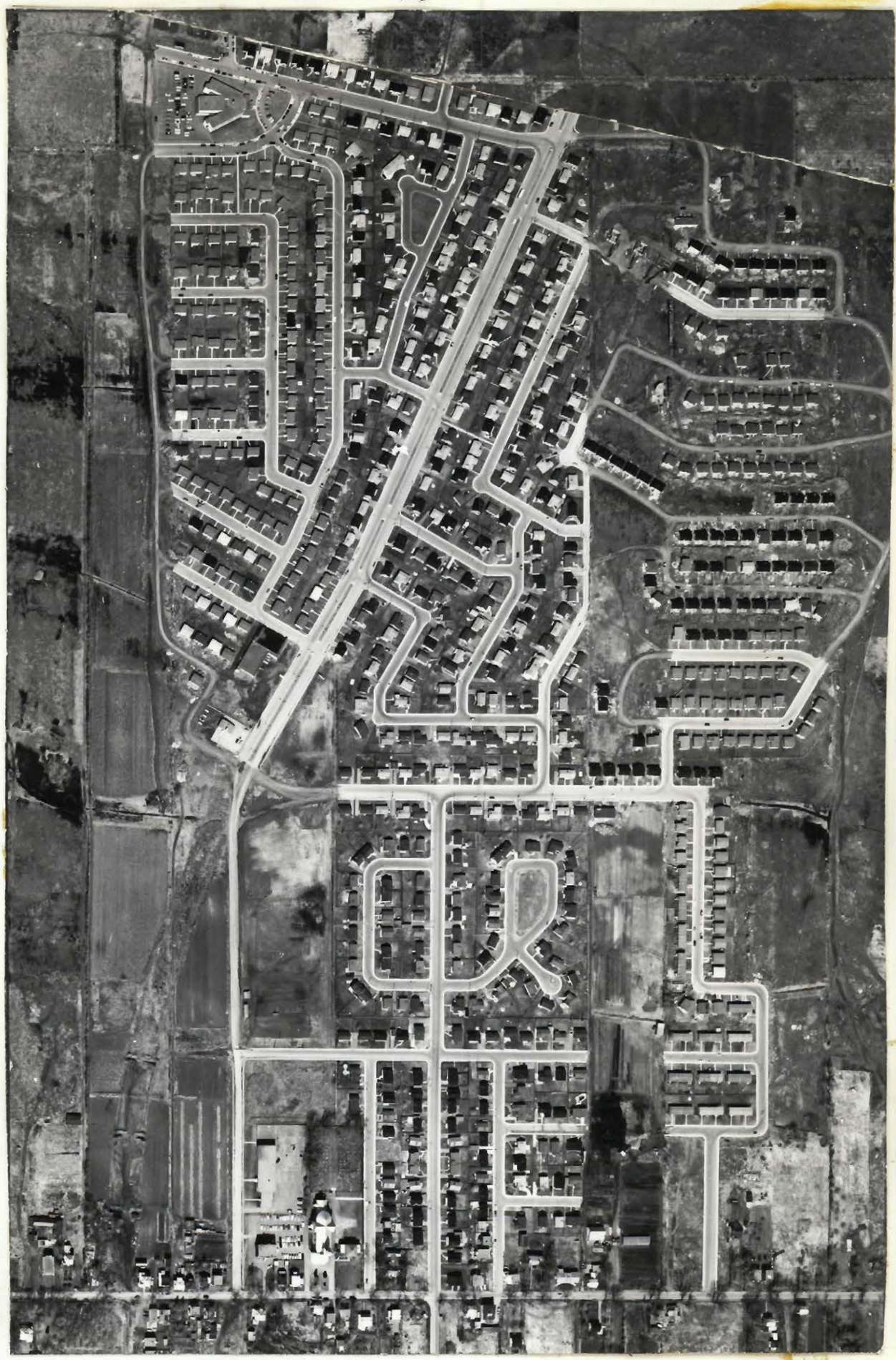
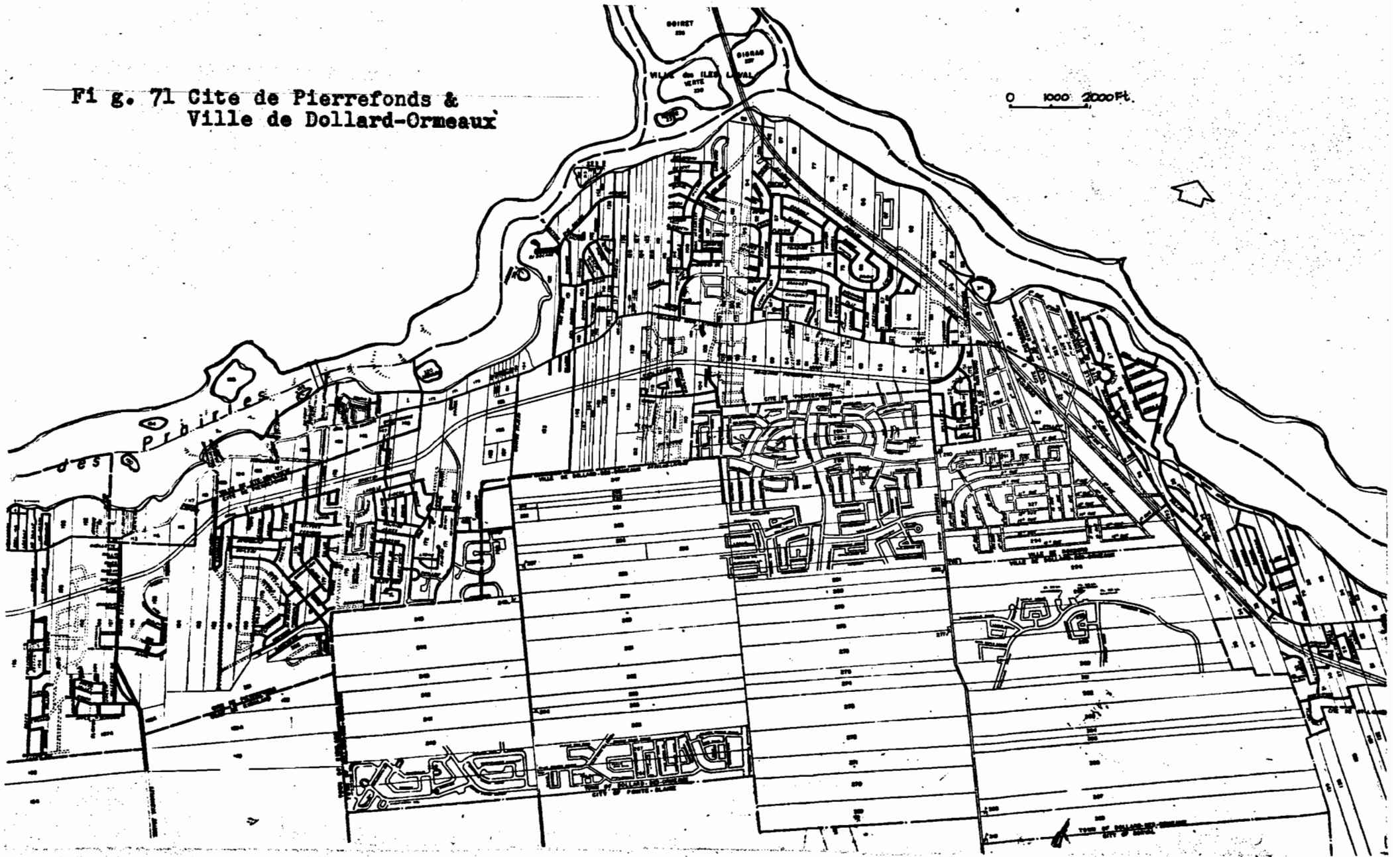


Fig. 69 Planned long lots - Cite St-Leonard

Fig. 70 Planned long lots - Cite de La Salle

Fi g. 71 Cite de Pierrefonds &
Ville de Dollard-Ormeaux



Aside from the above examples which were a part of a large master plan, most of the long lots had been developed as entities to fit into a number of lots. Because many long lots were under different ownership, the owners would make their own decision of when and how to develop them. Consequently, these planned long lots were essentially separate units of 'self enclosed' development. These planned long lots showed some variability in their street layout. For example, a symmetrical pattern of streets radiating from the octagon was created in the centre of St. Michel. It was deisgned by Beigh Charton. The central octogon was a park area in which the City Hall and a school were located. This radial street pattern (figure 72-c) was a departure from the typical gridiron layout of the surrounding areas. Another two examples with symmetrical pattern of street layout are shown in figure 72-a and figure 72-b. The former was located in south-east of City of St. Laurent. Designed by Charles Campeau, this pattern exploited the rigid formity of the crescent in a symmetrical manner. No main traffic route was constructed to penetrate this area, thus, peace and privacy were secured to some extent. The latter was located in the eastern part of the City of Montreal. This pattern was the arrangement of blocked grids in a symmetrical form and was designed to discourage traffic passing through this area.

(a) St. Laurent

(b) Montreal

(c) St. Michel

Fig. 72 Planned long lots in 1961

The Sunny Acres development was another planned subdivision of long lot located in Baie d'Urfe. The land, bought by Mr. R. E. Connolly in 1950 was two long lots of the southern farm. Connolly asked John Bland, an architect who was engaged in drawing up a master plan and zoning by-law scheme for Baie d'Urfe at the time, to design a subdivision plan that would measure up to the future demands of the municipality. As shown in Fig.73-b, the whole pattern of development consisted of a number of culs-de-sac which were placed perpendicularly to a winding road which was the main route of the area. In such arrangement, the dwellings would enjoy privacy, quietness, and a sufficiently extensive diagnonal view.

Another example of planned long lot was in Pointe Claire. The site was located on the north of Ste. Anne's Highway with a veteran's development (Fig.67-a) on the south. The builder intended to build a high density residential area. Designed by Louis Magil, the subdivision was more of a knit street plan in comparison to the culs-de-sac and crescent plan of the Veteran's housing. As illustrated in Figure 73-c, the whole developed area with loop road pattern achieved the desired privacy for the residences. Still another example was a small scale of planned subdivision with partial cluster layout form as in Figure 73-a found in the eastern part of the City of Montreal. There

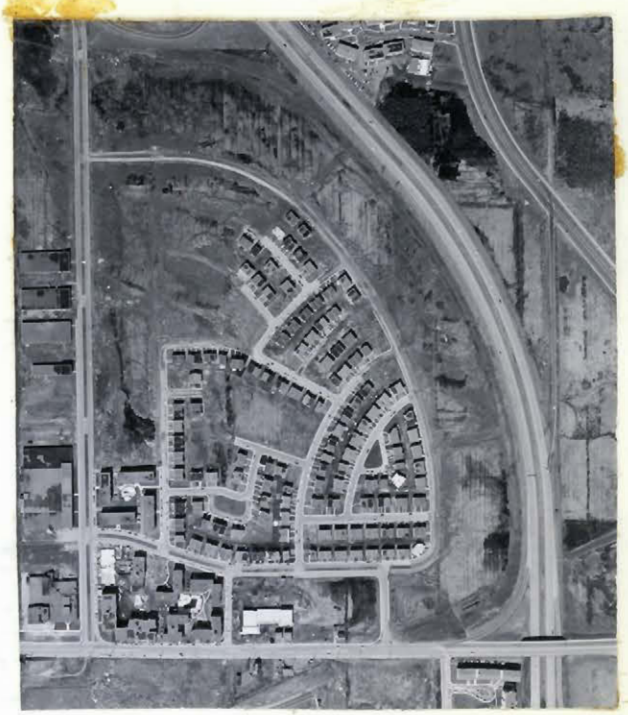
(a) Montreal

(b) Baie d'Urfé

Fig. 73 Planned long lots in 1961

(c) Pointe Claire

were many other street patterns with various 'grid' form layout in the planned long lots -- the curvilinear grids, blocked grids, and the enclosure layouts as shown in Figures 74 to 78. All these examples reflect that the developers tried to secure more efficient layout form, with a high degree of privacy and safety. They also began to make greater efforts to draw together a number of lots so that the technical and economic advantages of large-scale schemes could be realized, as the development of St. Leonard, Dollard-des-Ormeaux, and La Salle, etc. On this basis, the future development of street patterns on the Island of Montreal appears highly promising.



(a) St. Laurent

(b) Baie d'Urfe

Fig. 74 Planned long lots in 1961

(a) St. Laurent

(b) St. Laurent

(c) Montreal Nord

Fig. 75 Planned long lots in 1961

(a) Beconsfield

(b) Montreal

(c) Montreal

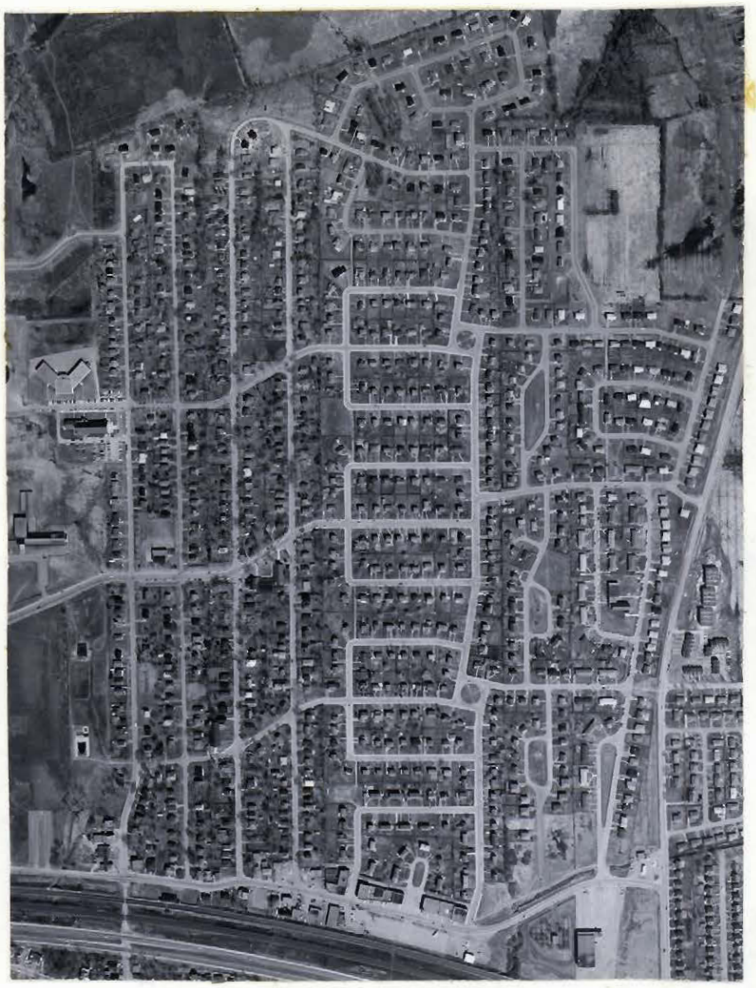
Fig. 76 Planned long lots in 1961

(a) Baie d'Urfé

(b) Montreal

(c) Pointe Claire

Fig. 77 Planned long lots in 1961



(a) Pointe Claire

(b) Dorval

(c) Beaconsfield

Fig. 78. Planned long lots in 1961

SUMMARY

SUMMARY

A review of the history of urban growth indicates that the evolution of street patterns was directly influenced by the form and growth of the city. Primarily, street patterns reflect the access and circulation requirements of the community which they serve; and it is quite natural for street patterns to evolve in the same tempo as the community grows.

The early known plans of cities indicate that they were mostly rectangular in form, and their streets were of the chess-board pattern. The Egyptian city of Kahun, the Greek city of Priene, and the Roman city of Timgad are typical examples of the gridiron patterns of ancient times. These patterns were succeeded by the more irregular layout which, for military and other reasons, prevailed in the Middle Ages. An example of this type of circular and fortified city with streets irregularly thrown about in the form of a maze can be found in Nordlingen, Germany.

By the time of the Industrial Revolution, because of the rapid rate of urbanization and the dire conditions of city living, the whole concept of housing and street layout was inclined towards improving existing patterns. It was in this period that the 'Garden City' idea of better living was first propounded. This

and other ideas of beauty, comfort and creativity culminated in the 'neighbourhood unit' suggestion of Perry and the super-block idea developed by Stein and Wright, in whose designs both neighbourliness and comeliness were stressed.

In Part II, the physical structure of street patterns has been classified into three general forms -- the grid system, the radial system, and the cluster-type subdivision. Each has its own characteristics and merits, and is applicable to certain conditions. Generally, the topographical feature of the ground will be a guiding influence as to the type of pattern to adopt.

In Montreal, the development of street patterns bears close relationship to the pattern of urban growth. The urban development of the Island has a marked variation in reference to the Central Area, the Western Section and the Eastern Section. These variations can be seen in the amount of planned growth that has taken place. An analysis of the urban growth presented in Part III of this thesis shows that it can take three basic forms -- the unplanned penetration of long lots, the planned long lots, and the comprehensive plans. The distinction among these three basic forms of street layout for residential purposes have been described in relation to urban growth on the Island for the years up to 1932, 1932 - 1952, 1952 - 1961.

The basic structure of urban pattern on the Island of Montreal showed up clearly since 1932. The centre of the City of Montreal was built up as nucleus of the whole structure. Away from the nucleus, there were three major lines of development -- the 'Western', 'Eastern', and the 'Northern' lines.

The 'Western' and 'Eastern' lines developed directly from the nucleus. In 1932, the 'Western' line of development was interrupted, but by 1962, it became a continuous line of development which reached as far as Ste. Anne de Bellevue bordering Lac St. Louis. The characteristics of this line of development were the 'infilling' and 'backfilling' which were especially noticeable at Pointe Claire where Montee St. Jean links the municipality with Pierrefonds. It would be interesting to think that this link might become one of the major structural elements in future urban development of the western part of the Island. The 'Eastern' line of development has become continuous since 1932. By 1961, this line of development proceeded rapidly, and the amount of infilling increased nearer to the nucleus.

The 'Northern' line of development was linked to the central nucleus by Montee St. Laurent. It was centered on the junction of the river road and the lot roads, and it stretched along the 'Chemin' facing Riviere des Prairies. By 1961, the central part of this development joined with the development which spread out from the nucleus. Its western development was best represented by Pierrefonds and its eastern line was nearly continuous with more penetration inland.

In 1932, the central nucleus already had too great an area of urbanized land equal to 78% of the total, therefore later development expended radially to some extent, but the major lines of later development were led by the existence of the 'Chemin du Roi'.

From 1932 to 1961, the changes in the urbanized area are presented in Table 3 on page 133 which is derived from Table 1 on page 97 and Table 2 on page 98. Over the entire Island, the developed area increased by 123%. The Eastern section grew more rapidly with 412%; the Western section increased by 318% and the Central area by only 62% because there was less available land for development. In this period, 81.5% of the changes in urbanized land for the Island of Montreal was due to unplanned penetration with rigid 'gridiron' street pattern; with 73.8% in the Western section, 89.9% in the Eastern section and 86.8% in the Centre. For the entire Island, 18.5% of the growth in developed land was due to planning, with the greatest proportion in the West. The noticeable feature was that the conscious desire to provide a better residential environment was increasing in degree of success through the planned long lots to the comprehensive plans. However, the unplanned penetration, by which the control of the patterns of urban growth is greatest, is still evident in planned long lots.

TABLE 3: Changes in Urbanized Area 1932 - 1961

	Island of Montreal	Central	West	East
1. Developed Land	36,414	14,339	16,202	5,873
% Change	123.1	62.2	317.8	411.6
2. Planned Long Lots	5,531.1	985.7	4,250.9	294.5
% Change	1,688.4	--	1,297.6	--
% Developed Land Change Due to Planned Long Lots	15.2	6.9	26.2	5.0
3. Comprehensive Planned Area	1,201.9	901.9	0.0	300.1
% Change	308.1	231.2	0.0	--
% Developed Land Change Due to Comprehensive Plans	3.3	6.3	0.0	5.1
4. Planned Area	6,733.0	1,887.6	4,250.9	594.5
% Change	938.1	483.9	1,297.6	--
% Developed Land Change Due to Planned Area	18.5	13.2	26.2	10.1
5. Unplanned Lots	29,681.0	12,451.4	11,951.1	5,278.5
% Developed Land Change Due to Unplanned Lots	81.5	86.8	73.8	89.9

An analysis of the type and the design of street layout of the subdivision was made at each period. It was seen that many planned street systems differed in the volume of vehicular incursions permitted into the residential areas. Several designs showed culs-de-sac as terminal elements of the street network. Some resolved the problem by varying internal street widths, designing circulation discontinuities, or otherwise in order to discourage traffic flow in the residential areas. Many of these designs were internally consistent with planning principles as seen in the development of Crawford Park, Verdun, and Cite Jardin, Montreal. They demonstrated the 'Radburn Superblock' ideas which were developed by Clarence Stein. Many planned subdivisions, in relation to the unplanned areas surrounding them, appeared to be incongruous. This implied that in most cases, a complete master plan for the municipality was non-existent. For example, the octagonal centre of St. Michel, with its radial street pattern affords sharp contrast to the predominant gridiron pattern of its neighbourhood. Likewise, the individually successful but uncoordinate subdivisions in Pointe Claire and Dorval also emphasize the need for a master plan. After 1952, many subdivisions were designed to fit into a master plan and are now in the process of execution, as in the development of St. Leonard or in La Salle and Pierrefonds. The comprehensive plans of the Town of Mount Royal and Ville d'Anjou represented a greater degree of success in the ap-

plication of planning principles. However, on the whole, the practice of comprehensive planning has not yet been widely followed.

The trend of urban growth, both past and present, on the Island of Montreal has distressed planners. Due to the lack of government control, many of the new developments, undertaken by private developers and therefore dominated by the profit objective, did not result in the most efficient use of available land resources. The key to rectifying this situation seems to rest in comprehensive planning.

The essence of comprehensive planning lies in the total approach instead of a fragmental one. It calls for a thorough study of the whole situation and the setting up of a master scheme covering all areas and problems in question. In order to prevent obsolescence, this scheme must be both dynamic and flexible; and it should be entrusted to a competent planning authority, able to deal with political and commercial repercussions. The master plan should have regard for the physical and economic condition of all areas to which it applies. Its responsibility to coordinate the development activities in various areas would eliminate the existence of incongruities. It is hoped that the adoption of comprehensive planning policies will help Montreal achieve the purposes of securing healthy conditions, amenity, convenience and economic use of land in the near future.

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SOURCE OF ILLUSTRATION

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	14	Verona, Italy	ditto
23	15	City of Palma Nova	Towns and Buildings
	16	Versailles, France	The Urban Pattern
	17	Karlsruhe, Germany	ditto
25	18	Philadelphia 1682	The Urban Pattern
	19	Savannah 1733	ditto
29	20	Robert Owen's Scheme for a model town	Rural Planning and Development
	21	J.S. Buckingham - Plan for Victoria	The Urban Pattern
31	22	Saltaire, Britain	Town Planning Review, Liverpool, Jan.1961
33	23	Ebenezer Howard - Garden City	The Place of the Ideal Community in Urban Planning
35	24	Pullman, Illinois	A Survey of New Town about Metropolitan Areas
39	25	Clarence Perry - The Neighbourhood Unit	The Place of the Ideal Community in Urban Planning

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Page	Fig.	Description	Source (full detail in Bibliography)
42	26	Radburn, New Jersey	Towards New Towns for America
44	27	Greenbelt, Maryland	Towards New Towns for America
	28	Greenbelt, Ohio	Towards New Towns for America
46	29	Greendale, Wisconsin	Towards New Towns for America
	30	Baldwin Hills Village, Los Angeles	Towards New Towns for America
49	31-a	Chicago Marquette Park & L. Hilberseimer's two proposals	The Nature of Cities
51	31-b	Beaconsfield, Montreal Island	Photographic Surveys (Quebec) Ltd., Sheet No.17-7364-0181 (Scale 1"/1000')Flown 4/1964
53	32	Nall Hills, Kansas City	The Homes Association Handbook
	33	Carrollton, St. Louis	The Homes Association Handbook
54	34	Nassau County, New York	Man-Made America: Chaos or Control?
56	35-a		
	35-b	Suggested hexagonal plan by Herr R. Muller	Town Planning Past Present and Possible
	35-c	Suggested hexagonal plan by Noulan Couchon	Journal of the Town Planning Institute of Canada, Feb. 1926.
61	36	Charlesbourg, Quebec	The Development of Land Settlement and Rural Architecture in the Province of Quebec
62	37	S.E. Sanders and A.J. Rabuck, New City Pattern, 1946	New City Pattern
65	38-a	T.Adams, 1934, The City	Design of Residential Area
	38-b	Oak Forest, Housbn, Tex.	Architectural Forum, Sept. 1949
68	39	Bayberry Community Syracuse, N.Y.	The Homes Association Handbook

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68	40	Ajax, Ontario	Community Planning Review, Feb.1951
69	41	Baronbackarna, Orebro, Sweden	Planning for Man and Motor
	42	Cite Jarden, Montreal	Planning for Man and Motor
70	43	Parkwood, Durham	The Homes Association Handbook
	44	Prince Goerge's County,Md.	Man-Made Americai Chaos or Control?
74	45	A Curvilinear Street Plan design by Community Planning Services, Inc. Pittsburgh	Man-Made America: Chaos or Control?
75	46	Six Moon Hill	Architectural Forum, June, 1950
	47	Aluminum City, Penn.	Architectural Forum, July, 1944.
77	48	Lidingo, Stockholm	Town Design
	49	Hilltop Community, Seattle	The Homes Association Handbook
79	50	Brendi Watwil, Switzerland	Encyclopedie de l'Urbanisme
80	51	Polperro	The Anatomy of the Village
81	53	Scientist Cliffs, Washington, D.C.	The Homes Association Handbook
	52	Lake Waukomis, Kansas	The Homes Association Handbook
84	54	Development of land settlement	Development of land settlement and Rural Architecture in the Province of Quebec
87	55	Development of Urban Use in a river range	Development of land settlement and Rural Architecture in the Province of Quebec
88	56	Unplanned Penetration - Rivière des Prairies	Photographic Surveys (Quebec) Ltd., Sheet No. 16-7364-0050(Scale 1"/1000') Flown 4/1964

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90	57	Types of Urban nucleus in the inland ranges	Development of land Settlement and Rural Architecture in the Province of Quebec
91	58	early development of inland lot system	photographic Surveys (Quebec) Ltd., Sheet No.17-7364-0181 (Scale 1'/500')Flown 4/1964
93	59	Town of Mount Royal	Photographic Surveys (Quebec) Ltd., Sheet No.15-7363-0041 (Scale 1"/1000')Flown 4/1964
95	60	Ville D'Anjou	Photographic Surveys(Quebec) Ltd., Sheet No.16-7343-0035 (Scale 1"/1000')Flown 4/1964
99-a	61	Urban Growth to 1932	Service d'Urbansime de Montreal, Land Used for Urban Purposes 1932 (Scale 1"/4167')Nov.1962
102	62	Planned long lots in 1932 (a) Beaconsfiedl (b) Dorval (c) Dorval	Photographic Surveys (Quebec) Ltd. Sheet no.18-7364-0097 15-7363-0028 14-7363-0195 (Scale 1"/1000')Flown 4/1964
103	63	Town of Mount Royal - early stage of Development	Royal Canadian Air Force Photograph (Scale 1"/1000")
105	64	Urban Growth to 1952	Service d'Urbanisme de Montreal. Land Used for Urban Purposes, 1952 (Scale: 1"/4167') Nov., 1062
107	65	planned long lots in 1952 - (a) Crawford Park, Verdun (b) Cite Jardin, Montreal	Photographic Surveys (Quebec) Ltd. Scale 1"/500' Flown 4/1964
109	66	planned long lots in 1952 (a) Montreal (b) Hampstead (c) St.Laurent	Photographic Surveys (Quebec) Ltd. Sheet No.13-7347-0062 13-7347-0062 16-7343-0081 (Scale 1"/1000') Flown 4/1964

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111	67	planned long lots in 1952 (a) Pointe Claire (b) Pointe Claire (c) Pointe Claire (d) Cote St. Luc, Montreal West	Photographic Surveys (Quebec) Ltd.Sheet No.16-7343-0071 16-7343-0071 16-7343-0070 12-7349-0052 (Scale 1"/1000')Flown 4/1964
113	68	Urban growth to 1961	Service d'Urbanisms de Montreal Land Used for Urban Purposes,1961 (Scale 1"/4167') Nov.1962
116	69	planned long lots - Cite de St. Leonard	Photographic Surveys (Quebec) Ltd. (Scale 1"/500') Flown 4/1964
117	70	planned long lots - Cite de La Salle	Photographic Surveys (Quebec) Ltd. Sheet No. 10-7346-0192 (Scale 1"/1000') Flown 4/1964
118	71	Cite de Pierrefonds & Ville de Dollard-des-Ormeaux	City Planning Department, Pierrefonds
120	72	planned long lots in 1961 (a) St. Laurent (b) Montreal (c) St. Michel	Photographic Surveys (Quebec) Ltd., Sheet no. 15-7363-0037 15-7363-0048 15-7363-0048 (Scale 1"/1000')Flown 4/1964
122	73	planned long lots in 1961 (a) Montreal (b) Baie d'Urfe (c) Pointe Calire	Photographic Survey (Quebec) Ltd. Sheet No. 15-7363-0053 18-7364-0095 17-7364-0187 (Scale 1"/1000')Flown 4/1964
125	74	planned long lots in 1961 (a) St. Laurent (b) Baie d'Urfe	Photographic Survey(Quebec)Ltd. Sheet No. 16-7343-0083 18-7364-0095 (Scale 1"/1000')Flown 4/1964
126	75	planned longs lots in 1961 (a) St. Laurent (b) St. Laurent (c) Montreal Nord	Photographic Survey(Quebec)Ltd. Sheet No. 16-7343-0081 16-7348-0083 18-7364-0127 (Scale 1"/1000')Flown 4/1964

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126	76	Planned long lots in 1961 (a) Beaconsfield (b) Montreal (c) Montreal	Photographic Survey (Quebec) Ltd. Sheet No.: 18-7364-0097 15-7363-0053 17-7364-0199 (Scale 1"/1000')Flown 4/1964
127	77	planned long lots in 1961 (a) Baie d'Urfe (b) Montreal (c) Pointe Claire	Photographic Survey(Quebec)Ltd. Sheet No. 18-7364-0095 18-7364-0199 16-7343-0070 (Scale 1"/1000')Flown 4/1964
128	78	planned long lots in 1961 (a) Pointe Claire (b) Dorval (c) Beaconsfield	Photographic Survey(Quebec)Ltd. Sheet No. 16-7343-0072 15-7363-0028 17-7364-0181 (Scale 1"/1000')Flown 4/1964