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PROCEEDINGS
OF THE SECOND POLISH-GDR GEOGRAPHICAL SEMINAR
SZYMBARK (POLAND) APRIL, 1972

CONTENTS

LIST OF PARTICIPANTS IN THE SECOND POLISH-GDR GEOGRAPHICAL SEMINAR

GERMAN DEMOCRATIC REPUBLIC

1. H. Lüdemann, Geographical Institute, Academy of Sciences of the GDR, Leipzig
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5. J. Heinzmann, Geographical Institute, Academy of Sciences of the GDR, Leipzig
6. F. Hönsch, Geographical Society of the GDR, Leipzig
7. H. Neumann, Geographical Institute, Academy of Sciences of the GDR, Leipzig
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9. H. Schmidt, Martin-Luther University, Halle–Wittenberg
10. D. Scholz, Martin-Luther University, Halle-Wittenberg
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POLAND

1. S. Leszczycki, Institute of Geography, P.Ac.Sci., Warsaw
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7. J. Grzeszczak, Institute of Geography, P.Ac.Sci., Warsaw
8. S. Herman, Institute of Geography, P.Ac.Sci., Warsaw
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11. S. Kozłowski, Institute of Geography, P.Ac.Sci., Warsaw
12. T. Lijewski, Institute of Geography, P.Ac.Sci., Warsaw
13. S. Misztal, Institute of Geography, P.Ac.Sci., Warsaw
14. M. Najgrakowski, Institute of Geography, P.Ac.Sci., Warsaw
15. J. Namysłowski, City Planning Office, Toruń
16. L. Pakuła, College of Pedagogy, Cracow
17. J. Rajman, College of Pedagogy, Cracow
18. H. Simbierowicz, Institute of Geography, P.Ac.Sci., Warsaw

REPORT OF THE MEETING

The Second Polish-GDR Geographic Seminar was held at Szymbark near Gorlice at the Polish Academy's of Sciences Geographic Research Station; from 17th to the 22nd of April 1972. The principle theme was the development of urban-industrial agglomerations with special reference to changes in the geographical environment of those regions. The Seminar was organized by the Institute of Geography of the Polish Academy of Sciences, according to the agreement between the Academies of Sciences of both countries. 13 German and 18 Polish scientists participated in the Seminar. On their way from Warsaw to Szymbark the participants of the Seminar visited the Old-Polish Industrial Region and sulphur mines, as well at the castle and museum in Baranów Sandomierski.

The Seminar started on the 18th of April with an address delivered by the Director of the Institute of Geography P.Ac.Sc. prof. dr S. Leszczycki followed by that of prof. dr H. Ludemann Director of the Geographical Institute of the Academy of Sciences of the GDR. 16 papers were delivered and several discussions were conducted during the three day session. The themes of the papers were as follows:

(1) The settlement system and the urban-industrial agglomerations (4 papers);

(2) Methods and results of research with regard to particular urban-industrial agglomerations (8 papers);

(3) The shaping of natural environment in the urban-industrial agglomerations (4 papers).

The Seminar Session was summed up by the chairmen of both delegations: prof. dr S. Leszczycki and prof. dr H. Ludemann. The participants of the Seminar accepted the final resolution summing up the results of the session. It was decided that selected papers are to be published in geographic magazines in both countries; in addition the whole scientific material was to be published in English in *Geographia Polonica*. It has also been agreed upon that the next Seminar is to be held in 1974/75, in the GDR, devoted to the theme "Man and his Environment".

On the 19th of April, following additional consultations, an agreement on cooperation between the Institute of Geography of the Academies of both countries was signed. On the 18th, 20th of April in the afternoon hours, the participants of the Seminar took part in short excursions to Biecz, Krynica, Poprad Valley and Nowy Sącz.

The last two days — 21 and 22 of April were designed to get the participants acquainted with the problems of Cracow agglomeration (21.IV. headed by Docent B. Kortus) as well as that of the Upper Silesian Industrial Region (21–22.IV. headed by Docent J. Rajman). In Katowice the participants of the excursion visited the Regional Planning Office and listened to a lecture on the problems connected with regional planning in the Upper Silesian Industrial Region; the lecture was delivered by its director Docent Zieliński.

GEOGRAPHIA POLONICA 30, 1975

THE PLACE OF URBAN AGGLOMERATIONS IN THE SETTLEMENT SYSTEM OF POLAND

KAZIMIERZ DZIEWOŃSKI

I. THEORETICAL AND METHODOLOGICAL QUESTIONS

In the growing number of geographical studies and planning schemes the concept of a "settlement system" is taken as the starting point and the main basis of construction. The concept itself is young and its definitions are rather general and not very precise, in fact — vague. The reason for the abandoning of the older concept of a "settlement network" is clear. The last concept was too much connected with the theory of central places. In particular there is included — implicite — the division of space, of the earth surface into the zones of influence of specific settlements, essentially the same in their function. In result all settlements are evenly distributed and it is assumed that the whole network is strongly hierarchical. However in the settlement system the functions of any single settlement are based on the social division of labour. Their location is a consequence of their functions and there is no "a priori" patterns of their distribution. In other words, with the settlement network the concept of continuous, isotropic (or even isometric) space is involved, while with the settlement system the space is identified with a discrete set of points, each with different locational advantages. The space is anisotropic in character and structure. The settlement network implies competition between the settlements; one settlement grows at the expense of its neighbours. On the other hand, the settlement system is based on cooperation and the growth of one settlement leads to the further development of others.

An analysis of the settlement system has to be multidimensional, based on simultaneous use of multiple methods. At least six problems are involved: (1) definition and structural analysis of the system, (2) description of its functioning, (3) delimitation of the system, (4) defining its environment, (5) the state of the system, and (6) measuring of its main parameters. The definition of the system itself involves identification of the elements of which the system is composed — in our case they are basic settlement units e.g. villages, towns, cities, large urban agglomerations. As in the all system research the main stress is being laid on the relations and interdependencies of the elements, one of the main tasks being to construct a matrix of all those elements — the settlement units. Taking into account the number of independent settlements in an average European country it is obvious that the construction of such a matrix is a too heavy task for both the analytical capabilities of human mind and technical potentialities of the largest computers. Hence the grouping of settlement units into settlement complexes, which may be treated as subsystems is a methodo-

logical necessity. Such grouping, however, involves specific generalizations and leads to the diminuation, if not complete elimination, of some information about the reality. As a result we have to face the problem of such grouping into settlement complexes — subsystems which would involve the smallest loss of information. This may be obtained by adjustment of grouping to the natural settlement complexes within which all human activities are at least partly closed. Then the loss of information due to the process of grouping and generalization shall be the lowest and perhaps insignificant.

In Poland to such settlement complexes belong, without any doubt, the large urban agglomerations which are usually categorized into metropolitan areas (essentially monocentric, with one main city clearly dominating over all other settlements) and industrial conurbations (policentric by definition, growing out of a more or less integrated set of industrial cities and villages, without any one dominating over the others). The third kind of urban agglomerations — recreational and tourist conurbation which is already well-known in the western countries, does not in Poland exist as yet.

Introduction of urban agglomerations as a basic element — a subsystem — into the settlement system creates, however, a number of difficulties both theoretical and methodological. How in such a case should cities, towns and villages located outside of the agglomerations be treated in the analysis of the whole system? Specific proposals were made to define settlement subsystems of a country on a regional basis i.e. corresponding to its economic regions. But then it is necessary to establish the complete division of the whole country into such regions and the criteria of regionalization have to be defined. Assuming the hierarchical organization of central functions as the starting point we quickly arrive to the identification of economic regions with the administrative units of higher rank (in Poland with voivodships). However, is it admissible to identify such units, which accidentally tend to change fairly often and rather quickly into radically different ones, with economic regions and their settlement systems or subsystems? And then what relation is there between urban agglomerations and those administrative regions? To what degree and for what area such agglomerations function as their central places?

Often enough urban agglomerations are located in the middle of economic regions of nodal character and of administrative regions as well, but in cases of industrial (and recreational) conurbations they may easily be in an excentric position. This phenomenon usually takes place when a new agglomeration starts to develop. Then the processes of spatial integration and of social entropy do not progress far enough and the regional structure is not yet adjusted to the settlement pattern. However, at present in Poland all urban agglomerations cover the central areas of economic regions with the exception of coastal regions where agglomerations nevertheless form the nodes of administrative regions.

Theoretically we may face three different situations: the area of an agglomeration may be smaller, equal or larger than the area of its nodal (or administrative) region. The first case raises a specific methodological difficulty in form of a question: to what subsystem belong those settlements which are located outside of the agglomeration. This difficulty increases when we assume that the settlement units forming the agglomeration may intertwine in space with other settlements of regional subsystem in such a way that some of the latter lie within the area defined as the agglomeration itself. The second case, although rare, is the one where the area of an urban agglomeration and of an economic region coincide. It does not create any more serious methodological difficulties. If we assume that the area of an economic region should be treated

as the potential area of its agglomeration then the first case may be considered as identical with the second one. In the third case in which the area of the urban agglomeration is much larger and crosses the boundaries of the region we face in reality a new phenomenon which may be called a "superagglomeration" and may be considered as an early phase in the development of the so-called "megalopolis".

These short reflections indicate clearly that the theory of urban agglomerations as subsystems in the settlement system of a country involves significant modification of the theories of central places. Urban agglomerations due to their size are so far outside the whole set of basic concepts involved in such theories.

Before approaching other problems, the identification and delimitation of urban agglomerations should be discussed in detail. In recent numerous publications, such as for instance those of S. Leszczycki and his associates, the number and size of urban agglomerations in Poland are extensivelly studied. In general the views are extremely divergent. However, if the problem is considered dynamically and agglomerations are treated as phenomena in time the major differences tend to diminish significantly. Urban agglomerations, like other settlement systems and subsystems, occur in space-time with some distinctive phases or even stages of growth. This implies that in successive periods of time they have different characteristics and structures. The differences of views about the number of urban agglomerations may be solved by their differentiation according to their state and phase of development. The division of agglomerations into growing ones, fully matured, finally transforming and integrating into the super-agglomerations leads to the concordance of almost all views and proposals.

The problem of delimitation may be studied with the help of numerous methods — simple or more sophisticated and involved. One of them, comparatively simple, was used by S. Leszczycki and his associates. Another, more complex (in an interesting way diversifying delimiting factors), called a method of an aggregated index, was presented during the First German-Polish Geographical Seminar (Halle, 1969) by E. Iwanicka-Lyra. The most sophisticated method — the multifactor analysis, was not yet applied in Poland. Lately a study of urban agglomerations was undertaken based on the use of this method which at the same time provides additional interesting information on their internal structures. With this statement we come to another important and as yet not fully solved problem. With internal structure of urban agglomeration which at least partly possesses a ring-like pattern — a new divergence of views develops as to which ring should be still included into the agglomeration itself and which already represents its external sphere of influence. Here we meet an additional theme, so far overlooked which with the growth in number of private cars becomes more and more evident. The question is to what extent an agglomeration is an area spatially integrated or even continuous. It is an important question, although the traditional views as well as old organizational and administrative, political, social and economic patterns and habits are most difficult to overcome. The assumption of an urban agglomeration with a discontinuous or even dispersed physical structure would allow us to solve another problem already discussed — that of spatial relations between agglomerations and their regions, which is still treated in form of a network of central places. In particular it would be convenient to identify the area of an agglomeration with its nodal region not only as the potential territory of its growth but as an area in which all more important urban centers belong to the agglomeration as a settlement subsystem. The division within the region into the

subsystems would not be then any more spatial, i.e., horizontal but hierarchical and functional, i.e., vertical. It is possible to assume also a mixed pattern of subsystems i.e. partly spatial, partly hierarchical. With such an approach local complexes of rural settlements would form in the regional settlement system the second subsystem, the first one being that of the urban agglomeration. Such a proposal implies of course a specific model of settlement system and subsystems. There is no logical necessity that in any country all settlement patterns and regional settlement systems would be formed according to one model only. In fact the analysis of the historical and contemporary settlement system of Poland indicates the existence of a wide diversity of such models.

But let us turn back to questions of urban agglomerations. As already mentioned, the most significant aspect is here the dynamics and stages of their growth. Research carried out so far indicates that there are two radically different or even opposed forms of growth and evolution as well as numerous intermediate cases.

The first of the radically different cases is the growth of the so-called metropolitan area which in its primary stage may be defined on the basis of a monocentric model with one main and dominant city in the middle. The characteristics of such a model and its mathematical formalization are fairly well identified and developed. It shall be sufficient to mention in this paper the following successive phases of development, all observable in Poland: (1) a city filling up completely an area defined by the 19th century fortifications, with only a certain number of summer residences and settlements in the peripheries (beginning of the 20th century); (2) strong and rapid ring-like growth on the land made available through the liquidation of fortifications as well as along the 4–6 main radial exits equipped at least with a good arterial road and railroad line (the first quarter of the 20th century); (3) a spontaneous, "mushroom" growth of the suburban zone with its characteristic specialized agriculture, housing estates, often of the substandard type and first decentralized industrial plants (the second quarter of the 20th century); (4) full crystalization and development of satellite towns originally only with housing (dormitory) functions, with industrial and service functions later added, finally renewed growth of recreational centers and settlements (the third quarter of the 20th century).

The second case refers to mining and industrial conurbations. In this field we lack a clear picture of their structure together with the identification of their successive phases in development, nor do we possess a logical and formalized model. In the last years I tried to formulate a general outline of specific development phases. I identified tentatively the primary phase of dispersed mining and industrial villages (till the middle of the 19th century), and the following one with an increase in their density and coalescence into larger although irregular units (second half of the 19th century). In the next phase various centers of services and social life emerged and a tendency towards creation of the main center for the whole conurbation began to develop (the first half of the 20th century). The final characteristic of the stage of full maturity for the growing urban community may be defined by its ability to defend its endangered existence by the substitution of new resources and new technologies for the traditional ones, by modernization or even by total change of the economic base of the whole conurbation (agglomeration), i.e., its economic profile and specialization (in Poland: the second half of the 20th century).

It may be observed by comparison of the data given that in Poland the growth of industrial conurbations preceded that of metropolitan areas. This specific characteristic may be explained by the fact of the political division of

the country during the 19th century with the main political and administrative centers located outside the Polish territories.

Another interesting phenomenon, this time of general character, is that both forms of development of urban agglomerations, although so different in their genesis and primary forms, tend to resemble one another in the final stages of their growth. It seems that we are facing here some kind of social entropy which evolves within the settlement system. With metropolitan areas there is a city which in the beginning is dominated by its central functions. In the end it acquires new, additional, highly specialized functions and evolves into an industrial region which, however, is oriented mainly towards its internal market. With industrial conurbations there emerges the main city of central functions within an area which is essentially an industrial region. These functions, however, possess a clearly endogenous character serving in the first place the very large population of the conurbation.

Lately another and new stage in the growth of urban agglomeration may be discerned which should perhaps be defined as the birth of "super-agglomerations" or of relatively integrated complexes of urban agglomerations. Agglomerations increase in number, in size and in area. Due to the technical revolution in the means of transport and of the constant improvement in the living conditions the spatial growth proceeds at a higher rate than tht population increase. This phenomenon forms an additional factor for the coalescence of more distant agglomerations and for the steady increase of their interdependencies New ties develop and the growth of internal markets leads up to stronger concentration and specialization both in production and in services. A new chapter in the story of technical, economic and social integration is beginning.

We do not possess as yet any theory or even a loose hypothesis about the emergence of super-agglomerations. Perhaps it is still too early. The only new spatial phenomena which we are able to observe so far are first, their negative consequences for the geographical environment with obnoxious influences of one agglomeration hampering or even seriously limiting the possibilities of growth and reconstruction of the physical structure of another. Secondly, the emergence of new internal, highly technically sophisticated transport patterns within and between urban agglomerations, specifically between their main service centers.

If the relations between adjacent urban agglomerations may be defined as factors integrating them together into new settlement subsystem — in form of super-agglomerations — it will be much more difficult to identify future development of the relations between the more distant ones. This difficulty is at least partly connected with lack of data and information about the present interrelations between already existing agglomerations. Without any doubt within the national settlement systems or even on a wider scale of such an international system there exists between the agglomerations, a specific social division of labour and functions. Such a division is the main basis of their existence and development. What is its strength? Are the ties between agglomerations stronger than those connecting the individual agglomerations with their surroundings, their region? In the first case we would have to face the emergence of a natural subsystem of urban agglomerations within the total settlement system. Within such a subsystem the full specializaion of large scientific and cultural centers could take place and be developed fully together with decentralization of specific functions of a national capital into other large urban agglomerations. Such decentralization was and is often proposed. In Poland it is to be incorporated into the proposed national plan of physical development. Such decentralization would be a real one. The often discussed alternative proposals for the

transfer of such functions to small or middle-sized cities or to some urban satellites of the capital (i.e. well within the capital agglomeration) turns out quickly to be unrealistic and therefore impossible in implementation.

In Poland the emergence of super-agglomerations, visible in the southern industrial region, may be, and perhaps should be considered as the beginning in the development of an integrated subsystem of urban agglomerations, leading towards the birth of the Polish "megalopolis".

In discussing problems of urban agglomerations and in particular their role in the national settlement system, their position in relation to the settlement systems of other countries, specifically neighbouring ones, should be taken into account. This applies, in the first place, to urban agglomerations located near frontiers. Such a study should be extended to include in their feedbacks the influence of these agglomerations on the Polish settlement system. These problems were not of greater importance so long as the frontiers remained practically closed in result of formal difficulties and controls involved in their crossing. With their even partial liquidation the influences may increase and become very significant. With the growing economic integration of the socialist countries the possibility of emergence of super-agglomerations located across or on both sides of the common frontiers cannot be excluded. Such agglomerations would be multinational in their economic, social and cultural character creating communities more complex and composite than those known in agglomerations developing in the last twenty-five years.

Problems of cohesion, stability and permanence of urban agglomerations, which are not really well known, may be omitted here as with very dynamic growth of existing agglomerations both in size and in area they cannot be decisive.

II. URBAN AGGLOMERATIONS IN TODAY'S POLAND

As it has already been mentioned there is a large difference of opinions as to the number of urban agglomerations in Poland. These differences may be reduced, to a great extent, to the variability of criteria used for the identification of an agglomeration and its area. They pertain particularly to the lower limit of population size of an agglomeration and to the size of the largest city within. They deal, therefore, not so much with its character and structure as with its size. We have already observed that the problem of size may be best clarified when various phases or stages in the process of development are considered. Starting from this point of view it may be stated that at present in Poland there are 9 agglomerations fully developed with one polycentric industrial conurbation and 8 metropolitan areas included (Upper-Silesian conurbation and metropolitan areas of Warsaw, Cracow, Łódź, Gdańsk–Gdynia, Wroclaw, Poznań, Bydgoszcz–Toruń, and Szczecin), 7 agglomerations partly developed, i.e., 5 industrial conurbations with main urban centres with population below 200,000 and 2 metropolitan areas without more developed suburban zones (Sudets, Kamienna or Old Polish, Bielsko, Opole, Częstochowa conurbations and Lublin and Białystok metropolitan areas) and 4 emerging agglomerations (industrial conurbations: at the confluence of the Wisła and San rivers and the Sub-Carpathian, Lower Silesian Copper District and a twin as yet undefined agglomeration of Kalisz and Ostrów); altogether there are from 9 to 20 agglomerations. The total number is the same as given by S. Leszczycki and his associates but the terminology differs. The terms proposed by me are based partly on genetical and typological approach (metropolitan areas and conurbations) and partly on morphological ones (main centers of services and social life).

Physical planners propose to add to this list two new agglomerations in southern Poland (those of Tarnów and of Rzeszów) and at a more distant moment two in the North (centered around the cities of Olsztyn and Koszalin).

The above mentioned agglomerations vary not only from the point of view of the development stages but also in their physical structure and the degree of concentration and cohesion. Naturally both these characteristics are involved in the processes of development but there are also other important factors. For instance all conurbations are by definition polycentric but even here Łódź, which was originally an industrial conurbation, is very highly concentrated, more than any other metropolitan area. On the other side, very often among those later ones there are cases of twin cities such as Gdańsk and Gdynia, Bydgoszcz and Toruń or Kalisz and Ostrów.

The average densities of the population in agglomerations as compiled by S. Leszczycki and his associates are varying from 150 inhabitants to 1600 inhabitants per 1 sq. km.

In such a situation a question may be raised whether and to what extent the already mentioned phenomenon of social entropy does take place in reality. Its existence is — in my opinion — fairly obvious and a strong reason for its development may be found in the unified, centrally established national planning and investment policies. But its intensity should be explored and clarified.

The intensity of entropy, i.e., of growing resemblance between urban agglomerations may be measured by the existence of differences and efforts towards their elimination or even liquidation. As an example, either the growth of central functions in the highly specialized industrial center may serve, as it happened during this century in Łódź, or, in opposite direction, the increase in specialized functions, specifically in specialized industries of such central places like Warsaw, Wrocław, Poznań or Lublin. There are parallel efforts towards the diversification of productive profile of industries in the conurbations. Such tendencies are notable for the agglomeration of Łódź but they are also present in the Upper-Silesian conurbation. This process is very characteristic of the transformation from a conurbation into a metropolitan area.

Another phenomenon is represented by the efforts to develop the main city or central service district for the so-far polycentric conurbation (e.g., the development of Katowice as the main center of the Upper-Silesian conurbation).

The emergence of satellite centers both in services and in industry, counterbalancing the so-far monocentric pattern of metropolitan areas may be considered as an analogous although opposite in direction, entropic phenomenon. Here cases of various new centers growing around Warsaw or the construction of Nowa Huta in Cracow and of Psie Pole in the vicinity of Wrocław may be cited.

Even recently a strong polarization among urban agglomerations as to their importance and cultural role was still surviving. The complexity and number of universities, schools and colleges as well as the number of students may serve here as a convenient measure. The concentration of the institutions of higher education in Warsaw, Cracow, Wroclaw, Poznań and Łódź was much larger and structurally more diversified than in the other urban agglomerations. In the second, rather distant place, were the agglomerations of Bydgoszcz–Toruń, Lublin, Gdańsk, Szczecin, Upper-Silesian conurbation and still farther down of Białystok and remaining centers. This kind of dichotomy was even more evident in the case of the analysis of the student recruiting basis. Only four centers: Warsaw, Cracow, Wrocław and Poznań possessed well-established wide regional spheres of influence. However, the last years brough some significant changes: the creation of new universities in Katowice and Gdańsk

has moved the Upper-Silesian conurbation and the Gdańsk agglomeration to the first group. In the case of the Upper-Silesian conurbation the institutions of higher education possess an endogenous character, i.e., they do not perform a wider regional function but satisfy the internal needs of a very populous area.

However, the entropy is not strong enough to make the full standardization of urban agglomeration feasible in a short period of time. The slow-down is at least partly due to the great immobility of the existing structures and patterns and the diversity of geographical environment in individual agglomerations.

One of the aspects which in the last years was an object of attention and research was the demographic structure, variable both in space and time. Generally speaking such a structure is a direct result of changes in the rates and factors of natural growth as well as of migrations.

The natural increase within agglomerations is low and it is falling down at a quicker rate than that for the whole country. This statement has to be qualified as the size of natural increase derives from the age structure of inhabitants which, in turn, is strongly connected with the volume of immigration in the preceding years, because among migrants there usually prevail people in productive age. On the other hand, the migratory increase is connected with the factual possibilities of employment, that is with the newly created workplaces. It is also connected with the cultural attractiveness of the agglomeration, specifically with the capacities and specialization in higher and professional education. However, the statistical data on natural increase and its structure for the whole agglomeration have not so far been collected. We possess them only for the central cities. These, although pertaining only to the core areas, reflect to a certain extent the conditions in the whole of the agglomeration. In addition the data on fertility were published only for the five cities forming administrative units on the voivodship (regional) level.

So far as the fertility is concerned there is a basic difference between Warsaw and Łódź on one side and the remaining cities on the other, where it is practically the same although by 25% higher than in the first two cities (indices of 35–36 and 43–45 live births per 1000 women in age from 15 to 49). So far as the indices of natural increase are concerned their variability is much greater. The lowest indices characterized Łódź (0.5‰ in 1971 and 1.9‰ in 1972) and Warsaw (0.9‰ in 1971 and 2.0‰ in 1972). The cities in the Upper-Silesian conurbation had in 1972 indices varying from 5.0–5.9‰ in the western part to 3.1‰ in the eastern part. The highest indices were observed in Białystok and Kielce (over 10‰). Very high indices were also characteristic of the western and northern agglomerations: Szczecin (9.8‰ in 1972), Gdańsk (9.0‰ in 1972) and Wrocław (7.7‰ in 1972). Relatively high index was registered in Cracow (5.8‰ in 1972). All these data indicate the significant influence of age structure on these indices and, therefore, of immigration. This element came out very strongly in Warsaw where in the last decade the immigration was sharply reduced through the employment policies and administrative regulations. As a result, specific negative consequences in form of quickly ageing population and low rate of natural increase, which in the long run does not even ensure the simple reproduction, were evident.

The influx of population from the outside is one of the obvious measures of relations between a city or an agglomeration and the external world. In a majority of cases the main recruiting bases for immigrating population were the immediate regions, the voivodships in which the given agglomeration was located. Generally speaking, from two-thirds to four-fifths of all migrants to

the individual agglomerations came from the corresponding voivodship. There was one significant exception: the Upper-Silesian conurbation with inflow from the whole country, and the most intense immigration from all southern regions-voivodships.

The population living in the sphere of influence and using the services concentrated in the given agglomeration would have been another convenient measure but the necessary data are not available and only rough estimates may be colated. One factor is sure: with an enormous development of bus services and the resulting increase in accessability of service centers in the agglomerations the number of regional customers is growing. Another piece of information available here indicates that the spheres of influence may often cross the boundaries of the voivodships, within which the given agglomeration is located. This is well illustrated by the fact that the drainage areas in the general migrations and in the student recruitment rarely coincide with such boundaries.

From the regional point of view there are only three voivodships (of Koszalin, Olsztyn and Zielona Góra) in which it is difficult to discuss the growth of new agglomerations, although in the case of two of them the physical plans provide for their development. Among the already developing agglomerations there are some where the future growth may meet with specific difficulties and impediments. Łódź represents a case of overconcentrated structure. On the other hand, the so-called Old-Polish industrial conurbation is primarily characterized by the dispersed development and by the concentration taking place on the outskirts of the original industrial region (cities of Kielce and Radom). In the voivodship of Rzeszów there are three separate areas which tend to develop into parallel agglomerations (the sulphur mining district at the confluence of the Vistula and San river, around the city of Rzeszów and in the valley between the Carpathians and their piedmont). Their simultaneous development may slow down the growth of them all. Finally there are the large and fast growing cities of Lublin and Białystok with a rather slow development of the suburban zone and satellite settlements which may easily lead to the overconcentrated structure. These are the problem areas but in all cases there are some problems of growth.

Finally it should be said that five southern agglomerations (the Upper-Silesian conurbation and the agglomerations of Cracow, Bielsko, Opole and Częstochowa) are already growing closer one to another. The process of integration into one super-agglomeration has — it may be said — already begun. Later on, this process may even extend first, towards Wrocław in the West and Tarnów in the East and later towards Łódź and Warsaw in the North. We are, in fact, witnessing the emergence of still higher and newer forms of urbanization and urban settlement.

III. PERSPECTIVES OF FUTURE CHANGE AND DEVELOPMENT

To forecast the future development of urban agglomerations in Poland may seem to be easy but in reality it is quite difficult and in certain elements unsolvable, therefore it seems to be impossible. We may be quite sure that considering the present dynamic growth the urban agglomerations will be much larger than they are at present. But certain conditions which have supported their growth so far shall change into the limiting ones. New constraints will probably arise soon.

Let us look more closely at these conditions beginning with the demographic conditions and structures. Lately Poland was characterized by a rather paradoxical situation: the country possessed very high rates of natural increase and,

at the same time, its population was practically stabilized throughout the last three quarters of the century. This was the direct result of population losses due to the two World Wars. The rates of natural increase, although widely fluctuating and diminishing in its secular trend, belonged to the highest in Europe and even at present — although seriously deflated — they are still well over the European average. If however the present situation and trends will persist, Poland similarly to the whole Europe, will became by the year 2000 a country of simple reproduction and of biologically stabilized population. There are even some pessimistic demographers who think that in the final stage even the simple reproduction shall not be ensured. They connect their forecast with a spread of the family model with one or at the most two children. The result is already clear. Among the demographic structural changes the first place is taken by the extension of life period for individuals and in result there is sharp increase in numbers of ageing population. The foreseable increase of the population till the end of the century be some 15–20% will be mainly connected with these phenomena. Excluding such destructions as another war Poland will have, by the end of the century, a population of almost 40 million. But larger reserves of manpower will not be available. This will be quite a significant change as so far we have been a rather unusual European state which had a large surplus of agricultural population that had served as the recruitment base for non-agricultural and urban population.

The fact of stabilized and ageing population has to have a significant influence on the growth and development of urban agglomerations. We have already observed that in Łódź and Warsaw the low rate of natural increase tends to fall below the limit of simple reproduction of their populations. The growth of agglomerations clearly depends on the immigration. So far it has been the rural population that was migrating even in case when such migration would be taken in several steps. However, by the end of this century the surpluses of the rural population will be exhausted. The further growth of agglomerations will have to take place at the cost of small towns and middle-sized cities or will have to depend on the reversal of trends in the rates of natural increase within the agglomerations themselves. This may seriously influence not only their growth but also their structure, in particular, their spatial pattern.

The increase in mobility of population, specially that of the inhabitants of urban agglomerations, shall create new settlement and housing pressures and problems due to the increase in number of private cars added to the increasing number of people in post-productive age, living in the agglomerations. The possibilities of migrations, both temporary and permanent, out of urban agglomerations has to be taken seriously into account. Their direction shall be to more attractive areas from the environmental point of view. A new form of "recreational conurbations" may easily develop and should be provided for. Certainly the over-all climatic conditions prevailing in Poland throughout the year do not form a propitious situation for the settlement patterns which have recently developed in California or Florida in the United States, or on the Riviera and along the shore of La Manche in Europe. Nevertheless, in the mountains, lakelands or even on the sea-coast possibilities of an extensive permanent recreational settlement should be seriously taken into account.

From all these remarks one conclusion may easily be drawn: further growth of urban agglomerations in Poland, foreseen as very strong, shall diminish at the end. By the beginning of the next century the agglomerations shall reach the stage of relative stabilization so far as the number of inhabitants is concerned. Their size shall depend mainly on their own demographic structure and in particular on the family structure.

On the other side, however, the increasing mobility of their population shall result in their further transformations and extension, as well as in the integration of individual agglomerations into larger ones (i.e. super-agglomerations) leading at the end to a clearly defined national settlement subsystem of urban agglomerations. In the last phase it is possible to foresee a total integration of such a subsystem with the whole settlement system in the country. In the longest perspective — at least in my opinion — such an integration of settlement in Poland should be taken for granted and it should be connected with full equalization of living conditions and far-reaching specialization in functions of single settlement parts of large Polish "megalopolis". Let us hope that Polish planners will be able to find satisfactory and effective spatial and landscape designs for such a settlement system towards which the spread of urban agglomerations is logically leading.

Urban agglomerations are already the dominant form of urban settlement, playing the role of main centers around which the population tends to concentrate. This role and function shall continue growing till in the end it will be fully identified with the basic pattern of the whole settlement.

Let us end these comments with some data illustrating these trends and changes in the role of urban agglomerations in the settlement system of Poland.

At present the urban population does account for more than half of whole population (53.1% in 1973) and by the end of this century it will be more than two-thirds or three-fourths of the whole population (in 2000 between 66.6 and 75%). In absolute numbers, 17.5 millions lived in the cities in 1973 and it is foreseen that in 2000 the number shall reach up to 30 million. The urban agglomerations were in 1973 inhabited by two thirds of the urban population and over one third of the whole population (i.e. about 12 million, but in the opinion of S. Leszczycki already in 1966 the number was 12,5 million). In the beginning of the 21st century it is estimated that agglomerations shall have 22–24 million inhabitants which means that they will comprise four fifths of urban population and three fifths of all the population. In the next fifty years their population will reach some 30 million, i.e., three fourths of all the population and the remaining ten million shall live in the concentrated settlements of urban type, within an easy reach of agglomerations. This last forecast is based on the assumption that the size of population shall remain stabilized, that there will be full integration of the settlement system, and the total territory of the country shall be polarized into areas of intensive and extensive land use. Within the intensive land use zone the dominant role shall be played by urban agglomerations, industry and mining; within the extensive land use zone — by agriculture, forestry, and recreation.

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SOCIETY AND SETTLEMENT. DEVELOPMENT TRENDS IN THE SPATIAL STRUCTURE OF THE GDR

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The problem of urban agglomerations has received much attention in geographical research of the German Democratic Republic for the last 10 years. This is explained by the historical development conditions of the spatial structure of this country and by the recurring present day phenomena regarding territorial development in connection with the development of the socialist society.

While it was the economic aspects of the agglomeration phenomena that prevailed initially, it is the ever more comprehensive questions of the development conditions and goals of the socialist way of life within the given territory that are now gaining main consideration. This is not merely a change of accent concerning the scientific question but the reflection of the new, wider socio-political objectives. The main social aim of the GDR of today is the steady improvement of the material and cultural living standard of the working population. The outcome of this are problems concerning applied research as well. This is, not to deny the economic implications, neither from the angle of the development of the national economy on the whole, nor from that of spatial development. On the contrary: it is the steady increase of social labour effectiveness that can ensure the material basis for the development of the socialist way of life. The further development of the socialist society must be accompanied by the scientific-and-technological revolution. In a country with a high standard of industrial development, as in the GDR, there is no other answer to the problem.

This is why issues concerning the development of the territorial structure of production and of the effectivity of economic growth in space rank so high in the geographical research. As the target has been set at the promotion of the socialist way of life the problems connected with settlement development, spatial physical development, and with man's environment are gaining special importance.

At the Second Polish-GDR Seminar, in continuation of the First Seminar of 1968, the discussion was focussed upon the problems of urban agglomerations. Here one could speak of an attempt to answer questions, involved in the further development of methods of geographical analysis. At the same time there is a need to discuss the theoretical bases of spatial analysis as related to the socio-political development goals in the socialist countries.

The theoretical and methodological problems of concentration, planned proportional development, and time budgets, as seen from the economic point of view, have become the subject of a scientific discussion. The same applies to

the sociological aspects of development of demand patterns as a social motive power, as well as to those of the development of the socialist personality within the society. With view to the geographical questions that arise from the above issues, the importance of identifying such regularities of spatial problems is increasing. They include above all:

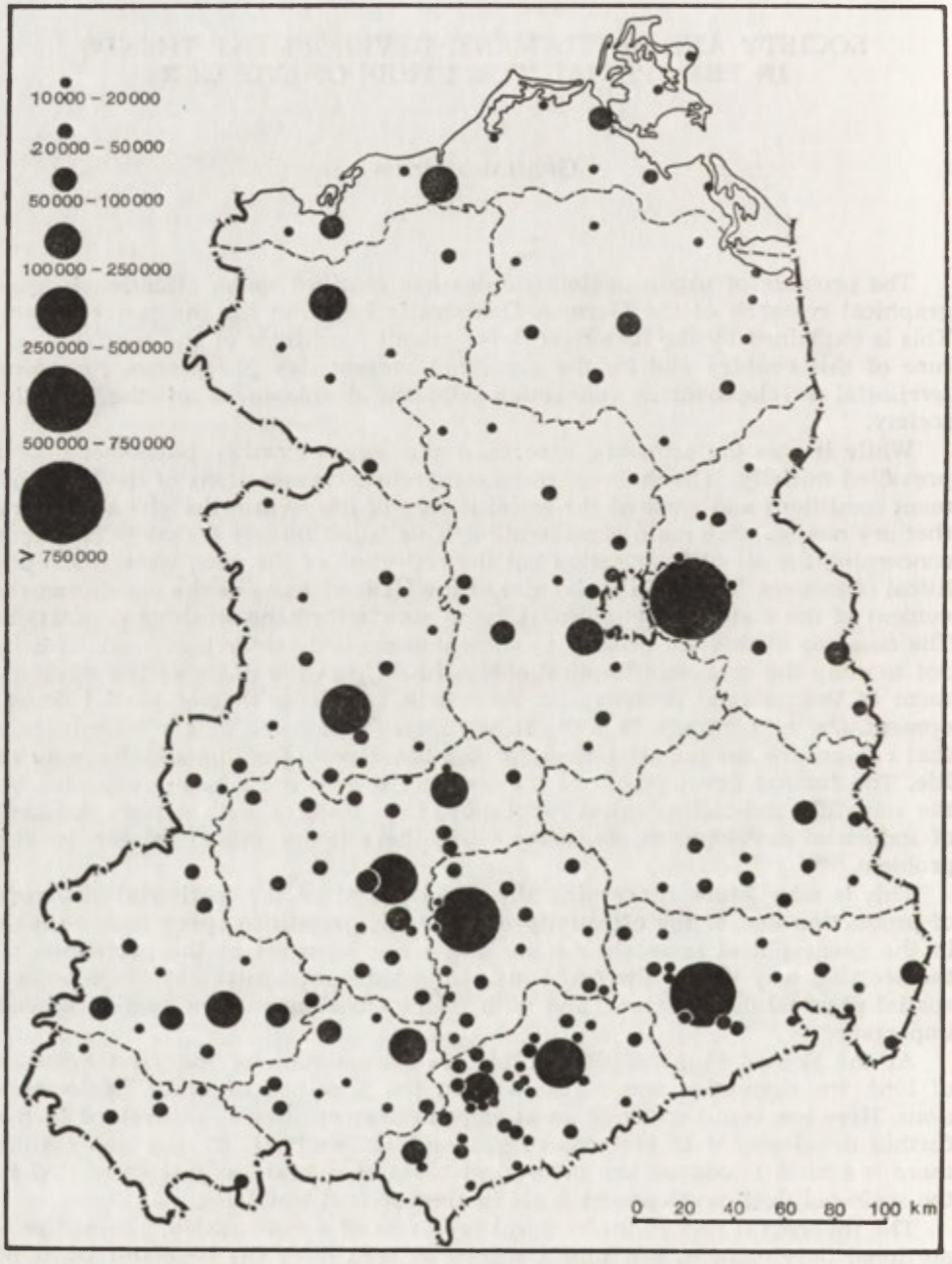

Fig. 1. Urban places of over 10,000 inhabitants

— local and regional agglomeration processes (concentration and production integration);
— territorial labour division processes (specialization and cooperation);
— urbanization processes;
— utilization of the territorial natural resources (particularly land use).

Questions of optimum proportions within the spatial organization of the society (G. Mohs, 1972) are also of importance. Territorial planning, in the GDR, follows in this respect the basic principles of rational utilization and spatial order. The goal is to create optimum conditions for the promotion of the socialist way of life. This is expressed by the settlement structure reflecting particular ways adopted by the society.

The settlement structure is an integral and integrating part of the spatial structure. It is emerging and growing depending on the distribution of productive forces. With this in mind, it is the man, together with his social activities and endeavours who decides about all the development issues of a settlement structure.

The settlement structure, with its complex nature, shows numerous interrelations with other partial structures of the territory in question. This is particularly true of the population structure, manpower structure, production structure, infrastructure and physical space (natural resources) and development (H. Förster, K. Scherf, 1971).

The settlement network in the GDR reflects the thousand-year old process of settlement development. Today there are almost 9000 administrative communes in the GDR, 7800 below 2000 inhabitants. The disintegration of the settlement system that can be traced back to the feudal era is actually deeper, since the administrative communes incorporate some 8000 settlement units and 10,000 individual hamlets.

Diverse distribution of industrial production centres is accompanied by substantial population concentration. The density is highest in industrial agglomerations and large cities. The districts of Halle, Leipzig, Dresden, Karl-Marx-

TABLE 1. Distribution of resident population of the GDR according to commune size categories (in %)

Size category ('000 inhabitants)	< 0.5	0.5–1	1–2	2–3	3–5	5–10	10–20	20–50	50–100	> 100
1950	6.9	10.8	11.3	5.9	7.8	9.2	9.0	13.6	4.8	20.7
1970	7.4	9.6	9.3	5.4	6.4	8.5	9.4	15.3	6.8	21.9

Stadt and Berlin — the capital of the GDR — occupy but 25 per cent of the total area of the country; they are inhabited by 50 per cent of the population, and yield 60 per cent of the gross industrial production.

The basic structure of the settlement network of the GDR is closely related with the density and territorial production effectiveness. The districts of Halle, Leipzig, Dresden and Karl-Marx-Stadt that comprise the industrial agglomeration areas in the South of the GDR, show the highest share of population by communes with more than 2000 inhabitants each. In the entire northern part of the GDR, on the other hand, only the district centers of Schwerin and Neubrandenburg, and four coastal cities fall within the category of large cities.

Out of the 1536 towns and communes within the districts of Rostock, Schwerin and Neubrandenburg, only 12 had over 20,000 inhabitants in 1970 (Table 1).

There arises a problem concerning general population trends and settlement concentration in socialist conditions specially in the GDR. This problem is at present open to a discussion with its theoretical-methodological and practical planning aspects. The basis for such considerations is that in long-term planning terms the scientific-and-technological revolution must lead to further concentration of production and of infrastructure. The directives followed in the GDR aimed at securing the socialist way of life and working conditions are in accordance with the optimum spatial concentration of material means to meet this end. For political, sociological and economic reasons this problem ranks among the leading in territorial planning.

The growing local and regional concentration, above all that of industrial production, and the growth of urbanization make the interaction pattern between man and environment more complicated. This particularly applies to urban agglomerations. Despite this, long-term planning insists on further concentration of industrial production, and further intensification of agriculture in the southern regions of the GDR. This is justified by economic reasons. It is the economic factors that decide about the possibilities of further growth of densely developed, highly-productive areas. Furthermore they decide about the possibilities of implementation of long-term plans to transform the structure of areas that were once dominated by agriculture.

The general principle of the growing spatial concentration will find its justification during the next decades not only in the industrial production concentration. The point of departure is the fact that a city is not only the most economical, but also the most advanced form of living and centre of the working class. Hence the social policy demand to re-model the settlement system and to promote the full urbanization within the GDR. Increasing urbanization is a global phenomena: In better developed and the developing countries its rate is now higher than ever in the past. Urbanization is but one aspect of general social development whose driving forces are the interrelations between the productive forces and production conditions within the given countries and regions. Urbanization can be generally defined as the process of concentration and the intensification of human communication as well as a process of integration of diverse social activities (A. S. Akhiyeser, L. B. Kogan, O. N. Janitski, 1969, p. 1020).

The socialist re-modelling of the settlement system in the GDR, based on socio-political and economical premises, will be implemented during the next decades, through a rapid development of a limited number of medium-size and large cities. Large cities allow to utilize complete structural advantages of concentration of production and science. The same applies to the socialist living and working conditions both in large cities and their surrounding regions. The trend towards the increasing concentration of population in large cities as a particular form of urbanization in the GDR during the last two decades, may be illustrated by the growing percentage of population in the higher size categories of communes (Table 2).

The process of concentration within the settlement structure is brought about by various factors. Initially, production concentration is responsible for local population clustering in the settlements. Concentration in the industrial sector in the GDR assumed considerable during the past two decades. This was due to the fact that in the case of state-owned plants there were no property limits that could hamper the development. This mas accompanied by the grow-

ing importance of large cities as centres of information exchange as the scientific-and-technological revolution advanced.

The concentration of production processes in agriculture is of growing importance. The cooperation unions, formed by voluntary collaboration of farm-

TABLE 2. Distribution of population in the GDR by communes (Gemeinde) within individual administrative districts (Bezirke) in % (1970)

District	Inhabitants ('000)	Size categories ('000) inhabitants										
		<0.5	0.5–1	1–2	2–3	3–5	5–10	10–20	20–50	50–100	>100	
Berlin	1085,4	—	—	—	—	—	—	—	—	—	100	100
Cottbus	861,1	14.9	10.9	7.4	4.2	7.4	11.7	6.5	20.5	16.5	—	100
Dresden	1873,1	4.8	9.3	9.5	5.6	6.7	6.9	8.0	17.7	4.7	26.8	100
Erfurt	1255,5	8.6	12.4	13.8	5.5	6.6	5.2	5.0	13.6	13.7	15.6	100
Frankfurt	680,6	12.0	9.6	9.1	5.6	10,1	8.2	13.4	22.9	9.1	—	100
Gera	738,5	13.4	7.9	6.5	6.0	5.5	6.0	13.6	14.1	12.0	15.0	100
Halle	1926,0	3.1	8.6	13.3	6.4	6.9	9.3	5.1	26.0	8.0	13.3	100
Karl-Marx-Stadt	2047,9	3.1	5.2	9.5	8.8	7.0	13.4	13.8	11.9	6.5	20.8	100
Leipzig	1490,6	5.0	10.0	5.8	2.7	3.9	9.7	9.6	14.1	—	39.2	100
Magdeburg	1317,5	8.5	10.8	11.6	5.9	6.7	7.7	11.8	16.5	—	20.5	100
Neubrandenburg	638,8	15.5	21.8	7.5	2.5	7.3	10.0	17.2	18.2	—	—	100
Potsdam	1132,8	13.1	10.8	8.1	5.2	8.0	12.1	11.2	13.4	8.3	9.8	100
Rostock	858,8	6.3	10.7	11.2	5.7	6.7	3.6	12.3	5.5	14.9	23.1	100
Schwerin	597,4	16.3	17.7	7.3	2.0	5.9	11.3	8.1	15.2	16.2	—	100
Suhl	553,0	9.5	12.8	15.8	11.8	11.4	9.0	14.0	15.7	—	—	100
GDR	17,057,0	7.4	9.6	9.3	5.4	6.4	8.5	9.4	15.3	6.8	21.9	100

ing cooperation brings about the concentration of individual production stages (the cattle breeding) within single facilities located in individual settlements. Furthermore one notes the growth of those units of the settlement network, in which the concentration of production processes and service facilities occurs, and which assume service function rendered for large areas (e.g. production and distribution of fodder, repair workshops for farm machinery). Finally the centralization of general eductional, cultural and public health facilities also affects the settlement concentration patterns. Its impact is the expansion of both cities and selected rural settlement centres.

The transformations within the settlement system will become particularly striking in the northern regions of the GDR. Their characteristic feature is not only the smallest share of urban population, but also a relatively high increment in the number of inhabitants. Due to the industrial development, certain small and medium-size towns in the northern districts will become large towns by the year 2000.

Anticipation concerning the agglomerations during the next decades also point towards further growth, above all of large-city cores, in spite of low development of the population potential in the southern districts of the GDR during the next two or three decades. The proportional development combined with amenities offered by large urban centres within agglomerations will bring about a further concentration of production and population in main and secondary centres situated along the axes of transportation and settlement systems.

Further expansion of large urban centres within the settlement system of the GDR involves problem of territorial planning aiming at curbing the excessive sprawl of such centres over surrounding areas. The goal is to maintain open space areas that would be sufficient to provide conditions for recreation and environmental protection. This is also the reason why socialist city planning favours a compact urban development. This is supported by land price policies which act against the encroachment of urban growth on highly-valuable arable land.

Still more important is the task of territorial planning to control the concentration process within the settlement network so as to guarantee the suburban population a rapid and comfortable travel to work in the industrial plants in the cities. This also allows the commuters to benefit from the high-quality cultural services offered by a city. Measures taken in order to improve the commuter traffic within industrial districts and agglomeration centres, will help to find the correct answers to this problem.

Generally speaking, the main task will be aimed at alterations within the settlement structure in such a way as to make them match the social demand on the whole and to secure working and living conditions of the population in all areas involved.

All guide-lines concerning the development of the settlement structure in the GDR, result from the above consideration. This provides for the future development of a sufficient number of medium-size sities (50–100 thousand) as regional centres, and for the expansion of a limited number of large cities, to supra-regional centres. Such regional and supra-regional centres would then form the macro-structure of the settlement system in the GDR. Their allocation over the territory of the GDR is to be planned in such a way, as to cover the entire territory by their influence zones.

The concentration processes within the settlement network, regarding the further development of regional and supra-regional centres bring up a question of development trends of the remaining settlements, particularly small ones. The discussion is far from being concluded. Even if the opinion is held that the still existing basic differences between town and country should be removed is not possible, in the foreseeable future, to think about such advanced concentration stage as to eliminate residential function of all small settlements (below 2000 inhabitants or so).

This is the reason why questions concerning city-periphery relationship are becoming of interest, both from the theoretical and practical angle. Settlement systems will have to be developed with a dominant role of those cities which form the system's macrostructure. This is the main task for territorial planning within next decades. To what extent one would have to develop systems of higher order, in the form of settlement clusters or belt structures, with their subdominant regional and supra-regional centres is still subject to discussion from the angle of both geography and territorial planning, as well as from that of town building aspects (G. Kaplan, A. Kotshokov, F. Listengurt, 1972).

With the present development of society and settlement in the GDR, one can (with reference to R. Bönisch, W. Ostwald, 1971) enumerate the basic trends of development of territorial structure of the GDR, as follows:

— Optimum territorial concentration of manpower with proportionate allocation of centres of production and social services over the territory of the GDR;

— Priority development and more-than-average growth of supra-regional and regional centres, with an attempt to level-off the development standard of regions;

— Specialization of centres and areas with attempts to raise the complex development within the territory;

— Increasing economic integration of individual areas; growing spatial interrelations and cooperation on a national and international scale.

Intensive scientific research programmes have to be carried out in order to substantiate this theoretical model of spatial structure of the GDR, the model which seems most suitable for the development of socialist way of life. Geography alone would not be able to deal with the task, although its accomplishment will call for a wide participation of professional geographers.

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SPATIAL STRUCTURE OF THE NATIONAL ECONOMY IN POLAND

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The urban-industrial agglomerations are the product of the socio-economic concentration processes, particularly active in the contemporary civilization era. Socio-economic concentration — a characteristic feature in the development of man's activity has been always subject to periodical fluctuations. It may be assumed that the division of labour subject to redistributions during its historic development is the underlying cause of concentration processes. The following factors are responsible for the intensification of socio-economic concentration in the present era of technical civilization.

— Revolutionary technological progress in all the domains of man's activity;

— Considerable development of production and services on the scale not encountered before;

— Rapid development of transport and information transmission systems;

— Development of education and growth of professional skills;

— Rapid increase of population and of its standard of living.

A considerable differentiation of spatial forms is a characteristic feature of contemporary urban-industrial agglomerations. The general tendency, though, is a spatial socio-economic concentration on the national scale with the parallel deconcentration within agglomerations. The phenomenon of deconcentration consists in:

— increase of the spatial extent of agglomerations;

— introduction of loose building forms in the central areas of agglomerations;

— changes in the distribution of jobs towards the lessening of their concentration in central areas;

— spatial growth of areas occupied by single family housing; transport and public green space;

— decrease of population density in agglomerations which is a result of the factors listed before.

The fact that besides heavily invested urban land the urban-industrial agglomerations include substantial agricultural areas, woodlands and recreation and tourist areas with specialized functions, should also be taken into consideration. These functions integrate the non-urban lands — into the agglomerations.

Deconcentration concerns the population in the first place, nevertheless it may be also observed in regard to industry, services, research institutes, institutions of higher education and others. Deconcentration processes within agglomerations lead to changes in their spatial structure which enable to meet more rationally the needs of their population and industry. That is why these decon-

centration trends may be regarded as favourable for the improvement of living standards of the agglomerations' inhabitants. This, however, requires a constant development of technical infrastructure.

Processes of spatial concentration are accompanied by the development of strong links between individual agglomerations and even by the phenomena of their spatial integration. These phenomena result from the need of cooperation and the interdependence in the field of specialized functions of the agglomerations as well as from the competition in the field of their central functions. The development of technical infrastructure ribbons may be observed. In the spatial economic structure of a country bundles of transport and communication lines are of major importance. Along them urbanization processes and the spatial and functional integration processes between agglomerations advance. Other elements of technical infrastructure ribbons (power transmission lines, gas pipelines etc.) do not induce urbanization processes along their course. It may be assumed that in the future both the previously mentioned elements as well as water pipelines will determine the directions of socio-economic and urban development. Thus, the fundamental framework of spatial economic structure develops. It is a policentric system consisting of nodes and belts where the role of main social and economic centres is played by agglomerations and additionally by smaller urban-industrial centres. By the term "belts" we mean communication links connecting the nodes and marking out the direction of urbanization processes.

1. A POLICENTRIC NODES-AND-BELTS PATTERN IN THE PRESENT SPATIAL STRUCTURE OF POLISH ECONOMY

Urban-industrial agglomerations are the basic nodes of the national settlement system. In an earlier study by the authors 16 urban-industrial agglomerations have been determined together with the urbanizing areas surrounding them.[1] The above mentioned agglomerations (Table 1) which occupy 26,900 km^2 (that is 8.6% of the country's territory) account for the population of 12,274,000 that is 39% of the national total. In the agglomerations the percentage of people earning their living from sources other than agriculture is over 75.5%. The same index for the whole country is 58.6% and for the areas outside agglomerations it is only 44%. The values are different for individual agglomerations.

Agglomerations account for 66% of the all country's employment in industry, 65% of gross fixed assets in industry and 67.5% of the country's total industrial production.

Cultural functions of the highest order and research functions show still greater degree of concentration within the agglomerations. All publishing houses, broadcasting and television stations and all film manufactures are concentrated there. 90% of theaters, operas, and concert halls, symphonic orchestras and musical theatres are situated there. Agglomerations account for 99% of research institutions with 99% of the staff, and 99% of scientific libraries. Out of the 85 universities and other higher education institutions in Poland 77 are situated within the agglomerations. During the academic year 1970/1971 those universities accounted for 98% of the academic and research staff and 96% of the total number of students.

[1] The method of delimitation of agglomerations and urban-industrial centres has been presented in the article: S. Leszczycki, P. Eberhardt and S. Herman — "The role of urban-industrial agglomerations in the spatial-economic structure of Poland", *Geogr. Pol.*, 27.1973. pp. 87–97. Cf. also the map enclosed to this article.

TABLE 1. Urban-industrial agglomerations, 1966–2000

No.	Urban-industrial agglomerations	1966				Area of expansion of the agglomerations between 1966–2000		Population of agglomerations (1966) territory as of 2000 (items 4 plus 8)	Population in 2000 as % of 1966 figure	Expected population		2000			
		Area in km²	Population		Population density per km²					Growth resulting from migrations and natural increase, 1966–2000		Area in km²	Population		Population density per km²
			Total ('000)	%		Area in km²	Population ('000)			Total ('000)	%		Total ('000)	%	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Katowice	6124	3032	9.6	495	680	49	3081	101.6	519	17.0	6804	3600	9.5	530
2	Warsaw	1893	1782	5.6	941	4740	482	2264	127.0	636	28.1	6633	2900	7.6	437
3	Cracow	2832	985	3.1	348	3270	357	1342	136.2	358	26.7	6102	1700	4.5	279
4	Łódź	587	932	2.9	1586	2450	318	1250	133.9	250	20.0	3037	1500	3.9	494
5	Sub-Sudetes	2641	722	2.3	273	3606	366	1088	150.7	212	19.5	6247	1300	3.4	205
6	Old-Polish	2691	633	2.0	235	4276	368	1001	156.5	199	19.9	6967	1200	3.2	176
7	Gdańsk	510	618	2.0	1211	1282	132	750	121.7	450	60.0	1792	1200	3.2	669
8	Bielsko-Biała	2564	553	1.7	216	529	41	594	107.4	206	34.7	3093	800	2.1	259
9	Wroclaw	482	510	1.6	1057	1426	144	654	128.2	246	37.6	1908	900	2.4	471
10	Poznań	455	501	1.6	1099	991	80	581	115.9	219	37.7	1446	800	2.1	551
11	Opole	3114	474	1.5	152	3110	266	740	156.1	260	35.1	6224	1000	2.6	161
12	Bydgoszcz–Toruń	384	399	1.3	1037	4366	527	926	232.1	374	48.0	4750	1300	3.4	270
13	Częstochowa	1521	398	1.3	262	2373	178	576	144.7	224	39.8	3894	800	2.1	206
14	Szczecin	420	331	1.0	786	1195	104	435	131.4	465	107.0	1615	900	2.4	557
15	Lublin	201	230	0.7	1145	621	60	290	126.1	110	37.6	822	400	1.1	486
16	Białystok	466	172	0.5	307	658	35	207	120.4	143	69.1	1124	350	0.9	311
	Existing agglomerations (total)	26,885	12,272	38.7	456	35,573	3507	15,779	128.5	4871	30.9	62,458	20,650	54.4	330
17	Rzeszów-Tarnobrzeg	×	×	×	×	5234	814	814	×	186	22.8	5234	1000	2.6	191
18	Carpathian	×	×	×	×	2435	432	432	×	68	15.7	2435	500	1.3	206
19	Copper Basin	×	×	×	×	2438	257	257	×	243	94.5	2438	500	1.3	206
20	Kalisz–Ostrów	×	×	×	×	1418	231	231	×	119	50.2	1418	350	0.9	246
	New agglomerations (total)	×	×	×	×	11,525	1734	1734	×	616	34.3	11,525	2350	6.1	204
	All urban-industrial agglomerations	×	×	×	×	47,098	5241	17,513	×	5487	31.4	73,983	23,000	60.5	311
	The remaining areas of the country	284,845	19,279	61.3	68	×	×	×	×	×	×	237,747	15,000	39.5	63
	Poland (total)	311,730	31,551	100.0	101	×	×	×	×	×	×	311,730	38,000	100.0	121

18 urban industrial centres as complementary nodes in the spatial structure of the country have also been identified. They include: Elbląg, Kalisz, Olsztyn, Legnica, Grudziądz, Rzeszów, Włocławek, Gorzów Wielkopolski, Zielona Góra, Słupsk, Piotrków Trybunalski, Płock, Koszalin, Tomaszów Mazowiecki, Inowrocław, Przemyśl, Gniezno, and Ostrów Wielkopolski. The above mentioned urban-industrial centres account for 3.6% of the country's population, 6% of total employment in industry and 6.3% of Poland's total industrial production.

The role of those centres as second degree nodes is determined by their functions and their location in regard to urban industrial agglomerations. In reference to function urban industrial centres may be divided into two groups. The first group includes voivodship capitals (Olsztyn, Rzeszów) and four cities where these functions are split into two complimentary centres, as in the case of Zielona Góra and Gorzów Wielkopolski or Koszalin and Słupsk. Three of those cities (Rzeszów, Gorzów Wielkopolski and Zielona Góra) when compared with other urban-industrial centres have considerable industrial potential. The second group includes all the remaining centres with industry as the dominant function.

Trends towards formation of new settlement complexes may also be observed. These complexes at present do not fulfil the criteria adopted in this article as the basis for identifying urban-industrial agglomerations. One such settlement complex develops due to emerging integration of Kalisz and Ostrów Wielkopolski, another is being formed from settlement units of the Copper Basin including Legnica, Głogów, Lubin, Polkowice and Bolesławiec. The third complex is situated along the Carpathian railway line between Nowy Sącz, Gorlice, Jasło, Krosno and Sanok.

In result of the territorial expansion of the existing 16 urban-industrial agglomerations a number of the previously mentioned cities will be absorbed by them by the year 2000. The development of other cities, within the next 30 years, must also be taken into consideration; in due time those cities may have to be regarded as urban-industrial centres according to our criteria.

It may be assumed that the policentric nodes and belts pattern, consisting of nodes (agglomerations and urban-industrial centres) and belts linking the nodes, constitutes a framework for the country's contemporary spatial economic structure. This framework is filled in by the following elements:

— urbanized areas;
— urbanizing areas;
— agricultural land;
— forests and woodlands;
— recreation areas and other related areas (such as inland water areas, wastelands and others).

Population increase in the agglomerations attest to the growth of their importance in the spatial structure of the country. During the ten years period (1960–1970) 65% of the national increase of population occurred within the agglomerations. Absolute increases for individual agglomerations were very differentiated. Another indicator of their growing importance is the industrial expansion in the post-war period. In all the agglomerations combined the employment in industry increased by 1,587,000 workers which gives 62% of the total national increase.

The following data represent the development rate of the urban-industrial centres. Their total population increase during the ten year period (1960–1970) was equal to 245,200 or 24.3%, which is two and a half times the national aver-

age. The increase of employment in industry (1946–1966) was over 167,000 which equalled 7% of the total national increase. During this twenty year period employment in urban-industrial centres increased four times.

2. PREDICTED CHANGES IN THE SPATIAL ECONOMIC STRUCTURE BY THE YEAR 2000

To propose a concept of future changes in the spatial economic structure at the national level we must consider various elements determining those changes. There are two types of elements: permanent elements which represent some potentialities or act as stimulating or as constraining factors, as well as non-changeable elements directing development processes and transformations in accordance with the changes in existing political, and economic conditions and socio-economic development.

Permanent elements include above all geographical situation. Its consequences are problems of the development of marine economy and transit connections between the USSR and Western European countries and between the Scandinavian countries and the South European ones. Resources and amenities of the natural environment constitute another relatively permanent element. The main role is played here by water and mineral resources, as well as soils and forests. Existing investment is regarded as a third relatively permanent element. According to Central Statistical Office data the value of Poland's fixed assets was equal to 3.8 billion zl in 1970. Over 50% of that sum was invested since 1945 that is in Socialist Poland. Considerable durability of technical infrastructure results in relatively small changes in the spatial structure of national economy.

Non-permanent elements include demographic and socio-economic phenomena and processes. The most significant among demographic questions is the population potential and its structure. According to the Central Statistical Office Poland's population will equal about 38 million by the year 2000. On the basis of the accepted concept of economic structure changes in Poland, we may assume the following occupational structure of its population:

— people earning their living from agriculture — 17% (about 6.5 million);

— people earning their living from industry and construction — 30% (about 11.5 million);

— people earning their living from the tertiary and quaternary sectors — 53% (about 20 million); total population — 100% (about 38 million).

There is a high probability that up to 1985 the increase of employment in industry, services and research will be of primary importance whereas employment in agriculture will decrease. We may assume that after 1985 the employment in industry will be rather stable and by the year 2000 the absolute number of people employed in this sector may even diminish. In such a situation the surplus of manpower will move to the tertiary and quaternary sectors.

Due to the development of technology the industrial production will be subject to automation and will respond quickly to the demands of consumer market which will grow in size. New industrial branches will take the place of old ones. The following branches of industry are bound to receive top priority: automobile industry, electronics, organic chemicals, and nuclear power generation. A high degree of automation and technological change will eliminate or diminish harmful effects on environment caused by nearly all industrial activities. Considerable progress will be noted in the field of public transport, thus increasing its effectiveness.

On the basis of all the previously quoted data we may assume that the *per capita* income will increase four or five times by the year 2000 in comparison with 1970.

The estimated increase of national income will cause real *per capita* income to rise probably three times in comparison with the present income. This increase will certainly lead to considerable changes in the structure of population demands. For example more money will be spent on private automobiles. Great increase of social demands in relation to housing conditions, both in quantitative and qualitative terms, must also be taken into account. This is strictly connected with the ever growing demand for family housing and the development of recreation areas.

According to the present development we may assume that the existing policentric pattern of nodes, and belts will continue to constitute the basic framework of the country's spatial structure up to the year 2000. New centres of the economic structure and new infrastructure belts will develop where new mineral resources extraction will develop or where new demands connected with regional development or international cooperation will arise. It may be, however, assumed that the existing nodal-belt pattern will determine the structure of the country's economy in the future. Major changes may be expected to come about within the system itself due to the modernization of technical infrastructure ribbons and related to the attempts at creating a more rational internal spatial structure of agglomerations and urban industrial centres.

Various interdependencies and functional links within the nodes and belts pattern lead to its integration *via* feedback effects. When analysing or planning further development of the nodes and belts pattern we must consider the whole system and not only its particular components. This statement will be valid for the next 30 years since further socio-economic concentration of economic and social activity is well under way in the existing nodes and urbanized belts as well as further development of communication and transport lines.

The division into urban and rural areas no longer adequate due to new forms of urbanization will totally lose its meaning by the year 2000. The division into agglomerations and the remainder of the country will take its place. Regional statistics and administrative divisions should be adjusted to such new division.

For all agglomerations, appropriately to their functions, size, population, spatial form and development phase there should be worked out development prognoses. As far as the remaining parts of the national territory are concerned, development plans should be worked out for urbanized areas, urbanizing areas as well as areas with dominant agricultural, forest, recreational and other functions. However, the division of population into agricultural and non-agricultural will retain its significance.

As we mentioned before, the population of Poland will amount to about 38 million, by the year 2000. It may be assumed that about 75% of the total population will live in agglomerations and urbanized areas, the size of which will by then increase, taking up over 20% of Poland's territory. The area which will be transformed into urbanizing areas due to changing living conditions and rising social demands, will be inhabited by 9 million people, out of which 4 million will earn their living from sources other than agriculture. Out of 6.5 million of agricultural population in 2000, 5 million will live outside agglomerations and urban-industrial centres. In addition, about 1.5 million of the inhabitants of agglomerations and urban-industrial centres will earn their living from agriculture.

About 29.0 million people will be living in agglomerations and urban-industrial centres as well as other important urban centres. The division of this population will thus be as follows:

— urban-industrial agglomerations	— 23.0	million	(80%)
— urban-industrial centres	— 2.0	„	(7%)
— remaining urban centres	— 4.0	„	(13%)
Total	— 29.0	„	(100%)

Fig. 1. Poland 2000. The nodes-and-belts pattern. Preliminary concept

1 — Urban-industrial agglomerations, 1966, 2 — Urban-industrial agglomerations, 2000, 3 — New urban-industrial agglomerations, 4 — Urban-industrial centres: 50—100,000 inhabitants, Urban-industrial centres: over 100,000 inhabitants, 6 — complexes of settlement units, 7 — highly dynamic industrial centres, 8 — centres of new mining districts, 9 — major transportation links, 10 — other important transportation links, 11 — directions of spatial integration (on inter-agglomeration level), 12 — major border crossings

The above population prediction up to 2000 anticipates an increase in population of urban agglomerations by over 10 million inhabitants (1966 — 12.3 million; 2000 — 23 million). This increase will be a result of:

— growth of the population already inhabiting the areas which by 2000 will be incorporated into the already existing 16 agglomerations;

— growth of population presently inhabiting the area of four additional agglomerations, which will develop in the future;

— growth of the population due to migration;

— natural increase.

The population presently inhabiting areas which will be incorporated into already existing agglomerations in the years 1966–2000 will play an important role in the demographic growth. The concept illustrating the spatial development of urban-industrial agglomerations existing in 1966 presented on Figure 1 as well as Table 1 show the scale of population growth in agglomerations as a result of their territorial expansion up to 2000. Within the boundaries of the existing agglomerations, as of 2000, the number of inhabitants totalled already in 1966 — 15,779,000 people. Thus, due solely to the territorial incorporation the population will rise by 3,507,000 — in comparison to the number of inhabitants of the agglomerations within the 1966 boundaries (12,272,000 inhabitants). The areas of four new agglomerations which will develop by 2000 namely: Rzeszów–Tarnobrzeg, Carpathian, the Copper Basin, Kalisz–Ostrów, were inhabited in 1966 by 1,734,000 people (see Table 1). Thus, we see that within the spatial limits of the agglomerations as set for 2000 there lived in 1966 — 17,513,000 people.

Thus the agglomerations' population growth in the years 1966–2000 due to migration and natural increase will be about 5.5 million. The results of studies on population change in the years 1960–1970 within the agglomerations (limits as of 2000) showed that population growth in this area during the decade, due to migration and natural increase amounted to 2,400,000 persons. Comparing those figures it is more than possible that the population of agglomerations will be 23 million in 2000.

Present processes of functional and spatial integration have already led to a clear-cut separation of large territorial units which have been formed by the coalescence of particular neighbouring agglomerations. The Southern Macroregion which encompasses the Katowice, Cracow, Opole, Częstochowa and Bielsko-Biała agglomerations is a typical example of such phenomena. The Macroregion whose area equals 5.2% of the country's territory was inhabited in 1970 by 5.8 million people, that is 18% of the total population of Poland. This Macroregion will enlarge its spatial extent both by encompassing the territories contiguous to the presently existing agglomerations as well as by territorial expansion along the main transportation routes. One of the directions of expansion may lead to a functional and spatial integration with the Wrocław agglomeration which also shall increase its territorial extent.

Very strong integration links will arise between the Southern Macroregion and the Sub-Sudetes agglomeration but this will not lead to their territorial integration. Though until 2000 a full spatial integration will not be achieved, the Sub-Sudetes agglomeration and the new Copper Basin agglomeration will have been incorporated into the Southern Macroregion. Because of its presently existing and also foreseen in the prediction period, high dynamics of economic and social development, in 2000 the Copper Basin agglomeration will meet the delimitation criteria determined by the authors. The agglomeration will include the following centres: Legnica, Lubin–Polkowice, Głogów and Bolesławiec. In 1970 this area was inhabited by 292,000 people.

The marked spatial development of the Southern Macroregion in eastern direction will lead to its full integration with the Rzeszów–Tarnobrzeg agglomeration which will be definitely formed in the prediction period. This agglomeration is made up of urbanized areas lying on the area of a triangle formed by the Dębica–Przemyśl, Dębica–Sandomierz and Sandomierz–Przemyśl railroad lines. These areas are already on their way to form an integrated complex of urbanized areas, which will have 882,000 inhabitants by the year 2000.

The Carpathian agglomeration comprised of settlement units reaching from Sanok, through Krosno, Jasło, Gorlice to Nowy Sącz will arise south-east of the Southern Macroregion. Beginnings of this urban belt, characterized by a large population (1970–497,000 inhabitants) and a relatively high degree of population density (185 persons per km^2), but a relatively small economic potential, could have been noticed already in 1970. It seems that because of the importance of the Southern Macroregion, and especially of the Cracow agglomeration, spatial integration precesses between the Carpathian agglomeration and the Southern Macroregion may take place during the prediction period.

The second large area to be formed within the next 30 years, as a result of integration between the Warsaw and Łódź agglomerations, will be the Central Macroregion. The formation of this Macroregion can be observed at present.

The urbanization processes which take place in the belt between the Southern and the Central Macroregion enable us to state that till 2000 spatial integration between these two large spatial units may be a fact. The twelve agglomerations which make up the spatially linked Macroregion will have a population of 17 million in 2000.

Six million people will inhabit the remaining eight agglomerations (Gdańsk, Szczecin, Lower Vistula, Old Polish, Poznań, Lublin, Białystok and Kalisz–Ostrów). Heavy development of the Gdańsk and Szczecin agglomerations is a result — according to the authors' assumption — of a major expansion of maritime trade and port facilities, the major part of which will be located in the two harbour complexes. A substantial spatial development of the Lower Vistula agglomerations, which is changing its pattern from the now existing bi-polar (Bydgoszcz–Toruń) into a policentric one, is due to dynamic development of the new industrial centres of Płock, Włocławek and Świecie–Chełmno as well as to important population and economic potentials of the remaining cities which will be incorporated into the future agglomeration. This will speed up urbanization processes along Vistula between Płock and Grudziądz.

Just as in 1966, the role of supplementary nodes in the nodes and belts pattern will be played in Poland, in 2000, by over 20 urban-industrial centres with a total population of 2.0 million. They are the following centres: Konin, Elbląg, Olsztyn, Koszalin, Słupsk, Gorzów Wielkopolski, Kołobrzeg, Piła, Tomaszów Mazowiecki, Siedlce, Zamość, Gniezno, Szczecinek, Starogard Gdański, Leszno, Ełk, Kutno, as well as three new complexes of settlement units — namely: Zielona Góra and Nowa Sól, Żary and Żagań, Chełm and Rejowiec. In comparison to centres marked for 1966 we see here differences which are a result of: first, formation of new agglomerations which will include the cities of: Kalisz, Legnica, Rzeszów, Przemyśl and Ostrów Wielkopolski; second, spatial development of existing agglomerations which will absorb the cities of Grudziądz, Włocławek, Piotrków Trybunalski, Płock and Inowrocław; and third, growth of cities which in 1966 were not yet marked as urban-industrial centres. Besides that, if a decision was made to extract coal in Lublin voivodship, iron ore near Suwałki or brown coal near Bełchatów, we should foresee a possibility of formation of new industrial centres based on extraction of mineral resources.

The mentioned nodes (agglomerations and urban-industrial centres) linked by transportation and technical infrastructure ribbons form an elementary framework of spatial structure of national economy in Poland, in 2000. Most transportation ribbons will run along railroad lines and intercity roads already existing in 1970. Transportation ribbons point-out, at the same time, the directions of urban development as well as of the development of spatial and functional integration between particular nodes. In the first phase integration trends are expressed in growing commodity flows and passenger traffic. Next, industrial cooperation and urbanization along the transportation ribbons will take place, leading in the last phase to a full spatial integration.

The remaining urban centres which in 2000 will reach 4 million people, were inhabited in 1966 by 3,200,000 people. Thus, in the prediction period, the population will increase there by about 25% in comparison to 1966. Among these centres there should be pointed out towns and settlements which in 1966 had a considerable industrial potential. The remaining small towns will perform central functions for agricultural, forest and recreational areas surrounding them. We must also have in mind that until 2000 these areas will undergo considerable changes. These changes will in the first place effect the living conditions, and will lead towards diminishing the differences between the living standards of these areas and of the agglomerations. Thus, the occupational structure as well as housing, service facilities and utilities will undergo a change. Simultaneously, these areas will meet the needs of the country in the fields of agriculture, forestry and recreation.

The agricultural economy will undergo serious changes pertaining to production and organization. Specialized, commercial farms will dominate, adjusting their production profile to changes in market demand and natural conditions.

Polish agriculture is in a condition to meet the demand of not only the country's own market but also to take over some leading functions in the field of intensive, specialized and labour-consuming cultures in the cooperation framework of the Council for Mutual Economic Aid. In order to achieve this, traditional rye and potato cultures must be given up and stress should be put on specialized crops, animal and fruit and vegetable production. A considerable raise in the standard of living of individual farm owners as well as workers of state farms will be the result of a considerable intensification which will guarantee the profitability of farms. Achieving this has a double — social and economic — importance. On the one hand, it may constitute a profit-oriented development of services for agriculture and agricultural population, and on the other hand, it may counter disadvantageous outflow of young labour force from agriculture.

In order to achieve this objective, protection of the best soils (class I, II and III) which constitute 30.4% of Poland's total agricultural lands, is necessary. Besides that, areas with a high degree of investments enabling highly intensive and specialized agricultural economy should be kept specifically for agricultural purposes. We should aim at protecting agricultural lands against erosion and industrial pollution as well as through rational drainage and irrigation against disadvantageous changes in water conditions.

Within the next 30 years, functions of forest areas will undergo serious changes. Although their productive functions will still be of considerable importance (about 2/3 of the national forest area) the protective functions of the remaining part of the forest area will serve social needs for recreation. Appropriate forest areas should be marked for recreation purposes, where adequate investments, to protect the forest against spontaneous tourist penetration, wo-

uld be made. National parks and reservations, in other words, totally protected forests, will make up the third group.

As far as preserving areas for the purposes of recreation, tourism and sport (water sports) activities is concerned, the main emphasis should be put on the unique, on a European scale, Mazury and Pomorze lake districts. These areas should be completely protected against industrial investments which might cause the degradation of the geographical environment. The above mentioned objections also refer to other areas of yet undestroyed nature which bear considerable value for recreation and tourism. As a result of a more "urbanized" style of life of most Poles in 2000 as well as a shorter workday, problems of recreation and tourism will grow in importance. We should have in mind that about 25 million Poles will have vacations and more leisure time. As far as week-end recreation is concerned, appropriate areas should be set up within agglomerations and their peripheries in such distances that they would be easy to reach within an hour's travel by means of public transportation. Summer houses built by agglomeration dwellers will probably become more and more common. As far as longer holidays are concerned, an important role, besides that already played by the lake districts, and the Tatra Mts. will be played by the whole mountain areas and the Baltic shore. Health resorts and climatic stations play an important role among other recreation areas.

A plan prepared by the Institute of Recreational Planning of the General Committee for Sport and Tourism provides for the protection of an area of 45,700 km^2 (14.6% of Poland's total area) against investments which could degrade the natural environment.

CONCLUDING REMARKS

The concept of a policentric nodes and belts pattern which constitues the main skeleton of Poland's 2000 spatial economic structure was based on an expected growth of cooperation and socio-economic concentration on a national scale. Concentration processes will lead to a considerable population clustering in agglomerations and urban-industrial centres which will together account for 65% of the country's total number of inhabitants.

Simultaneously, larger urban concentrations are undergoing changes leading to their transformation into loose settlement systems with differentiated spatial forms and considerable spatial extent. These agglomerations constitute today, and also will in the future, the nodal points with a high degree of concentration of human and economic potential. The nodes will constitute focal points for the development of economic and social linkages. The agglomerations at present already constitute cores of economic nodal regions. In the future the links of that kind will further develop. It seems that the linkages leading to the formation of Poland's contemporary nodal regions should be used in the future as a bases for revisions of the administrative division of the country. It also seems that the system of agglomerations and of nodal regions should be more widely utilized in regional statistics.

A differentiation in the spatial forms of agglomerations with the existing trends towards socio-economic concentration on the national scale, should lead simultaneously to deconcentration processes within agglomerations.

The phenomenon of deconcentration will first of all pertain to population which can choose dwelling place not in the central areas only but throughout the broader urbanized areas. The growing social demand for the development of single family housing is one of the leading factors of spatial deconcentration.

To a smaller degree, deconcentration trends pertain to the location of workplaces, whether in industry or services. Nevertheless, a change leading to a greater dispersion of places of employment within the agglomerations might also be expected. It seems that through urban planning there exists a possibility of the proper regulation of changes in the internal structure of urban agglomerations. Based on the notion of deconcentration processes, this planning might facilitate meeting sooner the needs of inhabitants while ensuring at the same time protection of man's natural environment.

The spatial extent of the agglomerations (as presented on Fig. 1) and their spatial forms do not predetermine their internal spatial structure. It should be remembered that within an agglomeration there will remain, apart from built-up areas, relatively large areas of intensive agriculture as well as forest and recreational areas.

A policentric nodes and belts pattern — treated in a very flexible way — enables to control changes in the spatial economic structure of the country as a whole and the transformation and development of its individual elements. There exist possibilities for dividing functions and socio-economic tasks among individual units according to, evolving in time, social and economic demands.

The year 2000 is simply a conventional date — it is the last phase of the changes occurring in the 20th century and the first of those of the 21st century. Thus, all predictions should be based on dynamic systems, thus taking perspective of further development and change.

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THE HINTERLANDS OF REGIONAL CENTRES IN THE GDR. FIRST APPROXIMATION

FRANKDIETER GRIMM

Investigations on the interactions of cities and their hinterlands have been carried on at the Geographical Institute of the Academy of Sciences of the GDR in the last few years. The following report gives an introduction to some assumptions and evaluations at the beginning of this research work. The report is limited to one important type of centres: regional centres, because the hinterland relations of these centres (including those of higher rank) are of main interest for the territorial planners in our country.

The concentrated effort of the economic geographical team in Leipzig since the Szymbark meeting has led to many new results. In the meantime a new level of knowledge on the interactions of centres with their hinterlands in the GDR and of the hinterland has been achieved. The main results of these investigations since the Szymbark meeting are as follows:

— analyses of the existing interactions between all towns in the GDR above 5000 inhabitants and their hinterlands;

— classification of all towns above 5000 inhabitants according to the importance for their hinterland;

— determination and modelling of the different zones of influence within the hinterlands, considering mainly traffic facilities, commuting, administrative boundaries.

Some of these new results have been already published in German, other publications have been prepared. They are listed at the end of the article.

1. THE CONTEMPORARY REGIONAL CENTRES AND CENTRES OF HIGHER RANK IN THE GDR

This report is based on the following tentative hypothesis concerning the term "regional centres" (*Gebietszentren*): Regional centres are of intermediate level between district capitals (*Bezirksstädte*) and county seats (*Kreisstädte*). They render services to both he intermediate and broader hinterland. These services of regional centres are beyond the capacity and scope of a normal county seat. The hinterland covers an area equal to that of several counties.

With this general understanding of the term as a starting point, more detailed features have been regarded as helpful in classifying the city in terms of a "regional centre". Such a characteristic encompasses the political-and-administrative importance of the city concerned, the population figures and the situation of the city in relation to others, as well as the size of the dominated region, i.e., of the area within which the city in question is the dominating

centre. Almost all cities with more than 50,000 inhabitants are regional centres or the centre of higher rank according to our definition. They dominate over an area inhabited by at least 150,000 people. Besides, some cities with 25,000 and 50,000 inhabitants are at present regional centres.

Since the functions of regional centres are also common to centres of higher rank, we shall consider both without any further differentiation.

The analysis has proved 43 cities of the GDR capable of being classified as regional centres or centres of higher rank according to the definition adopted, for example Greifswald, Neubrandenburg, Eberswalde-Finow, Frankfurt, Cottbus, Hoyerswerda, Görlitz and Bautzen. Those 43 districts and higher-order centres accommodate, with their 5.6 million inhabitants, nearly one-third of the entire population of the GDR, including:

3.0 million in 6 cities of more than 200,000 inhabitants,
0.7 million in 5 cities of 100–200,000
1.3 million in 16 cities of 50–100,000
0.6 million in 16 cities of 25–50,000

2. ON THE SURVEY OF HINTERLAND AND THE DELIMITATION OF DOMINANCE ZONES. FIRST APPROXIMATION.

The deductive classification of the established rank-size structure and relationships is based with regard to regional and higher-order centres on the following assumptions:

— specific contacts maintained to the regional or higher-order centres, are the necessity of all communities (*Gemeinden*);

— each of the regional or higher-order centres yields a certain equal spectrum of basic services, specific for such centres;

— every community maintains a priority contact with a single regional or higher-order centre and shows preference to the centre that offers the most favourable access to public transportation.

The above mentioned assumptions have proved sufficient to gain a preliminary understanding of the rank-size and spatial relations.

The following index has been adopted to represent the established and the possible city-hinterland relations in order to simplify further assumptions:

$$\text{Index of accessibility} = \frac{100 \times \text{mean travelling time}}{\text{daily travel frequency}}$$

The index of accessibility has served as the basis for the determination of the most favourable traffic connection for each of the communities to a neighbouring regional or higher-order centre. Such calculations were of primary importance for the delimitation of dominance zones.

3. THE PRESENT REGIONAL AND HIGHER-ORDER CENTRES AS DETERMINED BY MEANS OF THE INDEX OF ACCESSIBILITY

3.1. The size of dominance zones

With the above mentioned provisions and assumptions as the strating point, the following relationships and size orderings are distinctly outlined:

The GDR incorporates 191 counties (*Landkreise*) and 27 townships (*Stadtkreise*). On the basis of the introductory definition of the regional centres in respect to city-hinterland relations, we have found out 43 cities that meet the requirements. Every fifth county seat in the GDR can be considered as a regional or a higher-order centre. Therefore 4 county seats are on the average

subordinated to a regional or a higher-order centre. The mean size of a dominance zone would thus be calculated at 2340 km².

The dominance zones, as determined on the basis of the index of accessibility, show fairly varied area sizes. They range between 6500 sq.km (Stendal) and 570 sq.km (Aue). At the same time there is a clear correlation between the area and the population density: dominance zones of the largest size are found in sparsely populated regions, and *vice versa,* those of the smallest size — in densely populated regions.

The six largest dominance zones are found in the sparsely populated districts of the northern and central regions: Berlin, Stendal, Schwerin, Neubrandenburg, Cottbus, Magdeburg. 30% of the territory of the GDR, in terms of city-hinterland relations of regional centres is oriented towards the above 6 centres. The average population density of the above dominance zones (the 6 centres not included) amounts to 75 inhabitants per 1 sq.km. (The mean value for the entire GDR is 158 inhabitants per 1 sq.km).

The smallest dominance zones are situated in the densely populated South of the GDR. With the exception of the hinterlands of Leipzig, Dresden, Karl-Marx-Stadt and Erfurt, the size of the dominance zones in the southern districts is below the GDR-mean.

Less obvious, but still evident, is the relationship between the population total of a centre, and the area size of its dominance zone, particularly in respect to large cities. The dominance zones of 8 large cities of the GDR (Berlin, Leipzig, Dresden, Karl-Marx-Stadt, Magdeburg, Halle, Rostock, Erfurt), claim 29,000 sq.km, while the average area size for the remaining 35 centres is only 2100 sq.km each.

3.2. Population Totals of Dominance Zones

The size structure in terms of the population totals for the dominance areas can be calculated in a similar way as in the case of the first approximate estimation of area size. Since the 43 centres accommodate 5.6 million people, the population total of all dominance zones without the centres, would amount to 11.6 million. The average dominance zone without its centre, accommodates thus 270,000 inhabitants, or 400,000 inhabitants with a centre of an average size included.

The population figures calculated individually show considerable variation. The most densely populated are the dominance zones of Halle (850,000 inhabitants) and Leipzig (700,000 inhabitants). Berlin ranks 5th on the list. The smallest population figures per dominance zone are noted in the case of Wismar and Güstrow (each 90,000 inhabitants). The bigger population figures in the dominance zones of large cities are a result of basically higher population density and better transportation linkages. The lowest population totals of dominance zones are noted in the sparsely populated regions, and in the peripherally situated districts, e.g. Güstrow (low population density), Eisenach, Meiningen (peripheral situation).

3.3. On the different intensity of city-hinterland relations in the dominance zones

The delimitation of the dominance zones, and the calculation of the population total and area figures, allows for an initial estimation of the established size ordering. More precise statements will be possible while considering the differing intensity of contact within the individual dominance zones.

(*a*) *The 40-minute isochrone*:

The area within the 40-minute isochrone (net travelling time, public transportation) corresponds approximately to a distance that requires an effective travelling time of one hour from place of residence to place of work. This equals the extreme limit of zones of assumed commuting. Such a space is the area of the most essential territorial labour relations between a centre and the hinterland. The inhabitants are free to take the choice of jobs offered in a city, since they are capable of commuting to work daily. Such a favourable situation allows the inhabitants within the 40-minute isochrone to benefit wholly or partially from services offered by a centre. Accepting the 40-minute isochrone as the basis, the population total corresponding to the available manpower potential within a dominance zone can be calculated: 5.6 milion inhabitants in the regional centres, 9.5 million in the regional centres and their zone of 40 min. accessibility. On the other hand 7.8 million inhabitants of the GDR live beyond the employment fields of regional and higher-order centres and thus they can not take advantage of the favourable labour conditions and their changes. The above figure is a minimum value, as the 40-minute distance of net travelling time presents the extreme limit. If we assumed a 40-minute isochrone for walking distance plus travelling time, it would result in a population total of 10–10,5 million beyond that isochrone.

The largest population totals within the 40-minute zone (net travelling time), are noted with regard to the largest cities in the densely populated South of the GDR: Leipzig — 270,000 inhabitants, Zwickau — 260,000 inhabitants, Dresden — 250,000 inhabitants and Karl-Marx-Stadt — 220,000 inhabitants. The lowest population totals are — as could have been expected — in the sparsely populated districts of the northern and central GDR: Stendal — 35,000 inhabitants, Brandenburg — 35,000 inhabitants, Franfurt/Oder — 25,000 inhabitants. The average population total within the 40 minutes zone of each of the 8 largest cities amounts to 160,000 inhabitants, and 70,000 inhabitants in relation to the remaining 35 cities.

(*b*) *The index of accessibility: 500 value*

The index of accessibility 500 can be based upon various combinations of travelling time and travelling frequency. E.g., 8 travels per day taking 40-minutes or 12 travels taking 10-minutes. In accordance with our experience, the index of accessibility represents a range allowing people to benefit from the numerous services offered by a centre. By simplification, one can classify the zone with the 40-minutes isochrone as the area of established or potential territorial labour relations. The area within the 500 accessibility range is, on the other hand, the zone within which the employment and living conditions are marked or influenced by contacts with the centre, i.e., the area where changes occurring at the centre are also reflected.

The zones of accessibility values up to 500 accommodate 12 million people, which is more than in case of the 40-minutes zone; 2/3 of the GDR-population are capable of benefiting from the services offered by the centres. Nevertheless there still remain more than 5 million people beyond such areas. This one-third of the GDR-population must be ensured equal contacts with centres offering services. This demand of the social policy imposes an important limitation upon all concentration trends within the state territory.

The most remarkable differences between the 40-minute-zone and the zone of index 500 were found out in the hinterlands of big cities. The greatest population totals in relation to the index of accessibility 500 are noted for Dresden (530,000), Karl-Marx-Stadt (510,000) and Leipzig (400,000) followed by Zwickau, Halle and Berlin. Only small population totals are noted within the 500-zones of numerous centres of the sparsely populated North. This means that the

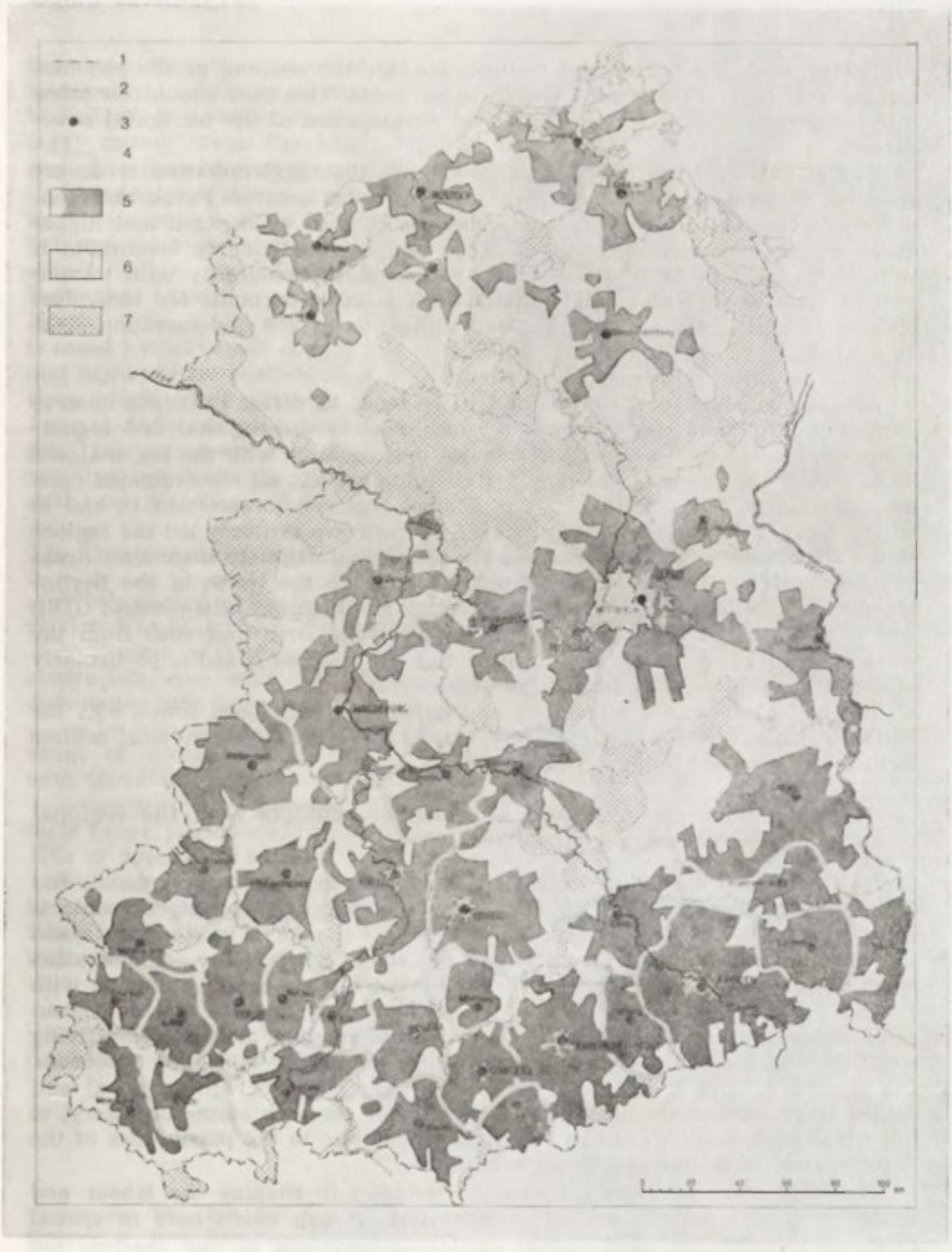

Fig. 1. Hinterlands of the regional centres

1 — state boundary; 2 — district (*Bezirk*) boundary; 3 — regional centre (including centres of higher rank); 4 — range of dominance; 5 — index of accessibility: below 500; 6 — index of accessibility: above 500; 7 — travelling time to regional centre more than 2 hours

This map was first published in Geographische Berichte and is here reprinted by permission of Professor Mohs, the Editor.

conditions, both qualitative and quantitative, for the shaping of the city-hinterland relations are different within those areas. This fact should be taken into consideration with regard to planned development of the territorial structure.

A regional comparison for the GDR shows that agglomeration areas are oriented, in terms of such relations, to higher-order centres. Favourable conditions in respect to city-hinterland relations (in case of regional and higher order centres) are characteristic of those regions. Particularly favourable is the existing possibility of contacts of an individual community with various centres. The variety of possible interactions is of importance for individual citizens as well as for the planning and utilization of the agglomeration areas as a whole.

(c) Areas beyond the intense contact-zones

Areas situated beyond centres and their zones of direct influence deserve particular attention. The relations of such areas to the regional and higher-order centres are relative small. Assuming that contacts with the regional and higher-order centres are necessary for all communities, all shortcomings must be presented. It will require a more detailed research to ascertain if, and to what degree these assumptions are real. At present we can only list the regions of the GDR within which such areas are noted, and estimate their size. Areas beyond the intense contact zones are the regions to the North of the Berlin–Magdeburg line (coastal districts not included) the Fläming hills (central GDR) and certain smaller peripherally located areas. The strip that runs from the western Altmark towards the eastern part of the Usedom island is particularly distant from the regional and higher-order centres.

The distant areas are either sparsely populated, peripheral zones, e.g., the Altmark region or densely populated smaller areas with their own local centres as in the case of the Halle district.

3.4. The structure of hinterland in terms of contacts with the regional and higher-order centres

Maps showing the delimitation of the dominance zones of regional and higher-order centres within the GDR show the varying intensity of contacts in relation to the 43 centres. The maps offer a basis for a preliminary assessment of the city-hinterland relations of the above centres. The agglomeration areas are clearly distinguished as showing most intense spatial relations with the centres. Two advantages of the agglomerations appear. The one is an availability to utilize fully the existing potential relating to labour and living conditions. The other is a possibility to utilize manpower and other resources. On the other hand there are areas where close contacts with regional and higher-order centres are hardly feasible. Further research seems necessary, to tell which of those areas are in fact handicapped due to the possibilities of the improvement of labour and living conditions.

The importance of county towns (*Kreisstädte*) in shaping the labour and living conditions deserve special consideration. A gap exists here in spatial planning policies carried so far in the GDR. According to our analyses the overwhelming majority of large county towns are situated within the 500-zone (index of accessibility) of the 43 centres. Exceptions are only four cities of over 25,000 inhabitants situated beyond the 500-zone of the regional or higher-order centres (Wittenberge, Sonneberg, Schwedt, Luckenwalde). The latter, perhaps with the exception of Wittenberge, do not have sufficiently large hinterland to assume the role of a regional centre, according to our definition. Apart from

the above exceptions, most of the larger county towns are situated relatively favourably in relation to their regional and higher-order centres. Their own hinterland is however restricted to immediate vicinity. This double-role of many county towns has been already emphasized by Mohs and Scholz with regard to the cities of the peripheral area in the Halle-Leipzig agglomeration.

The analysis of the city-hinterland relations proves that the larger areas in the southern regions of the GDR accommodate large county towns situated between the regional and higher order centres, e.g. Döbeln between Karl-Marx-Stadt and Dresden, Naumburg and Weissenfels between Weimar and Halle, Bernburg, Stassfurt and Aschersleben between Halle and Magdeburg. The North of the GDR on the other hand, apart from the district of Rostock, is noted for only small county towns, and those show no closer ties with regional and higher-order centres. Such a diverse starting point requires specific solutions which would give due consideration to the network of small centres and low population density. Latest research on the city-hinterland relations within the GDR has proved that the majority of such relationships, important for the working and living conditions of the population have developed between residential communities and the corresponding county towns.

3.5. Comparison of regional and higher centres considering the hinterlands

While analysing the territorial and higher-order centres, in terms of services rendered to hinterland, the following distinction should be made:

— centres with their dominance zone maintaining intense contact with the centre (e.g. Aue with 97% and Zwickau with 95% of population within the dominance zone according to accessibility values of up to 500);

— centres with dominance zones still substantially more extensive than the range of intensive contacts (e.g. Bautzen, Leipzig, Mühlhausen and Wismar with 50–60% of population within the 500-zone; the GDR average — 55%);

— centres with dominance zones situated essentially beyond intense contacts range (e.g. Schwerin with 6%, Stendal with 9%, Neubrandenburg with 11% of population within the 500-zone).

Further research stemming from the deductive-abstract study of the city-hinterland relations is aimed at a closer analysis of the figures and interrelations presented, as well as at the examination of their correlations with empirical results.

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ON TERRITORIAL STRUCTURAL EFFECTS AND THEIR ECONOMIC ROLE WITHIN AGGLOMERATIONS

DIETER SCHOLZ

1. INTRODUCTION: THE PROBLEM, ITS ECONOMIC AND SOCIO-POLITICAL IMPORTANCE FOR THE EXPANSION OF THE DEVELOPED SOCIALIST SOCIETY IN THE GDR

The advance of planned shaping of the developed system of socialism in the GDR proceeds within a territory the economic- and geographical structure of which has been determined by centuries long development process. It was the process of pre-socialist formations of the society (commenced with the relicts of early feudal settlement structures). This has been followed by attempts at providing more rational territorial structures to answer the requirements of the socialist working and living standards. It was particularly the development of the past decade (ever since the socialist production conditions have succeeded in the agriculture) that has triggered a process aimed at essential changes with view to the inherited territorial structure. The results of this process are new as to their quality, and their target is a territorial structure to suit the demands of the socialist-communist society and of scientific-technological progress.

At the moment we are facing the beginning of this process which for our present knowledge may claim an undefinite period of time until it is finished. This process differs from the entire heretofore development of our territorial structure. The difference consists in the fact that the course taken by this process is anything but spontaneous and running underneath the threshold of congizance of the society. On the contrary, it is consciously and planfully controlled by the socialist society.

This fact has the effect of the two comprehensive and extraordinarily important tasks which the organs responsible for the territorial planning and research are faced with:

1. The necessity of determination and formulation of objective social and of special economic laws (or principles) to control the development and shaping of the territorial structure. Conscious application of such principles would permit such a development.

2. The necessity of formulating targets for the control of the territorial development process in the GDR. Such targets must answer the requirements of the future socialist-and-communist society.

The scope of problems to be discussed below encompasses the territorial structural effects and their effectivity within the agglomerations of the GDR. It belongs to the former complex of tasks and is therefore of basic importance

for the long-term or prognostic developments. It harbours at the same time a most up-to-date reference: the directive of the SED VIII Congress for the years of the 5 year plan period 1971–1975 points to the "Intensification and increasing the effectivity" of the social production as the leading path towards reaching the goals for the national economy. This demands undoubtfully also an increased territorial effectivity of production, as well as an improvement in the working and living standards of the population.

A scientific approach to this field has commenced in the GDR but several years ago, and from the angle of regional economics from the very beginning. The starting point was marked by the research conducted in *Ökonomisches Forschungsinstitut* of the State Planning Commission on the questions of improvements within the agglomerations, on the problems of an effective utilization of local resources, on the territorial structure of national gross product, as well as on the problems of the research of territorial economy spending (Rationalisierung, 1967; Territoriale Ressourcen, 1967; Ergebnisse, 1968; G. Lindenau, 1968). The above efforts were used by Ritzschke (1967) as the basis for his comprehensive study which resulted in the formulation of a system of territorial effectivity calculus (G. Ritzschke, G. Kind, 1969). The system presents an attempt at summarizing the heretofore highly varied as to their details, empiric analyses from a more general angle. It is furthermore aimed at their classification and at rendering them at the same time an universal instrument for the determination of the effectivity of territorial structures. Thus, the above work lays stress on the methodic aspect, while its theoretic bases appear rather weak, and strongly marked for empiric preliminaries.

Similar is the procedure adopted by J. Heinzmann (1971). His dissertation on the large agglomeration core of Leipzig refers to the leading groups of factors that determine the effectivity of the production structure of a territory (development trends of the scientific-and-technological progress, shaping the structure of production, development of the territorial production management, dislocation of production within a certain territory), and attempts to find quantitative criteria for the above.

Attempts made in this line encompass further research, e.g., the work by the Institute of Industrial Construction of Deutsche Bauakademie (1971) and that by the Office for Regional Planning in Cottbus (1971).

The theoretic discussion on the problem of the territorial effectivity, on the other hand, lags behind empiric research. The beginnings may be found in the paper by R. Bönisch, W. Ostwald (1971), and in an unpublished research report by the Working Group on Agglomerations of the Geographical Section of the Martin-Luther University, of Halle–Wittenberg (April, 1971). The most comprehensive discussion to date is contained in a paper by R. Bönisch (1972).

The above brief review of the present position of scientific achievements permits the following conclusions to be drawn:

1. The scope of problems involved in the territorial structural effects — to the territorial effectivity relations is of great importance for the long-term and prognostic as well as for the present tasks of the territorial planning.

2. The literature available in the relevant fields supplies some empiric research results and notions. The latter, apart from being oriented at practical results, communicate methodical possibilities and experiences.

3. The theoretic penetration of the scope of questions is involved only at the initial stage and must be at any rate promoted in order to ensure a correct evaluation of the practical results.

The above purposes are meant to be served by this paper. It is based on the practical experiences gained by the Working Group of Agglomerations of the

Geographical Section of the Martin-Luther University in Halle, and supported by the discussions carried out by the members of the Group (Professor G. Mohs, Dr. H. Schmidt, B. Gallander, E. Trawnicek, and G. Kroll).

2. ON THE ESSENCE OF TERRITORIAL STRUCTURAL EFFECTS AND THEIR IMPORTANCE

Discussion on the contents of both the basic terms "territorial structural effects" and "territorial effectivity" must be made the starting point for the following considerations.

The term "effect" denotes in the first place any action (*Wirkung*) or a result thereof (*Auswirkung*) in general. A structural effect may thus be solely an outcome of a specific structure or of a change in a specific structure.

A territorial structure (economic area, territorial structural unit, etc.) is to be understood as a spatial sector of the entire social structure of a country including her natural basis. The territorial structural unit presents a highly complex formation (or a system) of most varied material objects, relations and processes which form such a unit, and account at the same time for its extraordinarily complex structure. Such a structure is noted for the totality of relations between the individual segments (elements, structural components), as well as for the proportions between the elements and structural segments.

Thus, all effects could be looked upon as structural effects which result from a structure of a certain territory or from its alterations, i.e., from the relations and proportions between the elements of the territory in question or partial structures.

Such effects are extremely manifold and contradictory. An attempt at bringing them into an order or rendering them more perspicuous requires the application of certain principles and of correct starting values. Those result from the definitions of territorial structural elements and components, and from the definition of territorial relations and proportions.

If to conceive according to G. Schmidt-Renner (1961, p. 11) the production (and social reproduction, D. S.) location as the basic element of the territorial structures, such an element may be considered in its double respect to the larger territorial partial structures in the following summarised way:

1. According to the type and degree of spatial linkages and concentration of locations of most varied nature, such factors result in complexes of locations, sub-territories, and in other levels of spatial units of a territorial structural unity. As their size grows, those latter are becoming ever more complex, although they are already relatively complex in their elementary forms.

2. If to consider locations of a similar nature (i.e., equally formed sectors of the social reproduction process within a territory) one will be able to distinguish partial structures (like the territorial structure of production, that of population, etc.) which will reflect in their whole again the territorial structure.

In this connection, the territorial structure may be described both as a spatial structure matrix (according to B. J. L. Berry, 1964, as quoted by R. J. Chorley and P. Haggett, 1967, page 28), or as a vector field (according to G. Kind, 1969). It is particularly the former representation (Table 1) that seems better suited to reflect the essential relations and proportions of a territorial structure. It may be used to classify the basic territorial structural effects. The latter may be grouped according to the following categories:

1. Effects resulting out of the material substance of the territorial structural elements:

TABLE 1: Territorial structure matrix according to Berry (1964), modified

				Territorial structure													
				Production				Population				Resources . . .					
				Manufacturing		Agriculture		economically active		economically passive		Area		...			
				further differentiation													
Territorial structure	Subarea 1	Complex 1	Location 1														
			2														
		2	3														
			.														
			.	Locations as elements of territorial structure													
			.														
	2	3	.														
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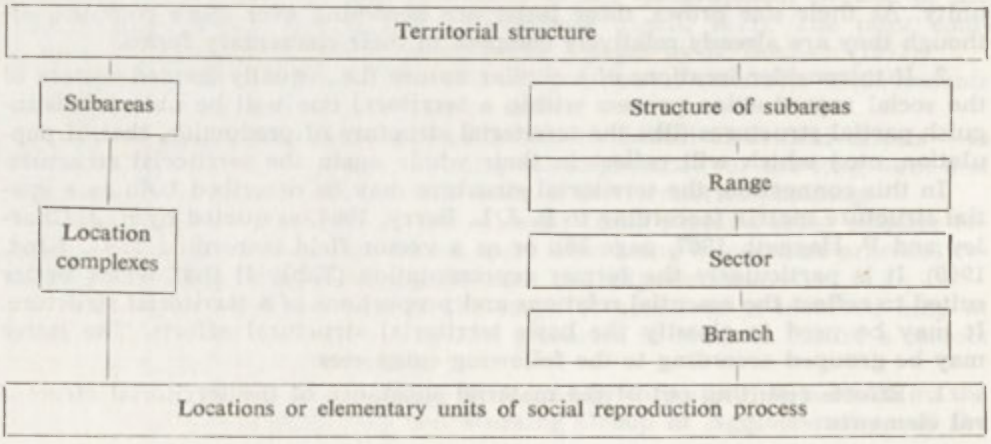
Main possibilities of structural representation of the elements of territorial structure



1.1. Properties of the natural material substance permit to obtain the following:

— Effects resulting from a given territory being provided with resources;

— Effects resulting from a given territory being provided with substance that can be won as raw materials.

1.2. Properties of a material substance produced by the society by working, permit to obtain the following:

— Effects resulting from a given territory being provided with infrastructural facilities;

— Effects resulting from a given territory being provided with dwellings and industrial buildings, and thus with a population and settlements.

Such effects are triggered in the case a society is willing to make use of the above properties, and the proper substance is sufficiently or insufficiently available. This requires a remark that sufficiency or insufficiency are relative values that result each time from the relation between the demand and the possibility of meeting the demand.

2. Effects that result from the relations and proportions between the territorial structural elements, i.e., of the territorial management of the reproduction process at given locations, location complexes, etc. The most essential relations of that type include:

2.1. Situation relations as the most general relation of the territorial type;

2.2. Flows of commodities resulting from requirements of the territorial production management, circulation and consumption;

2.3. Flows of population resulting from the requirements of the territorial management of production, circulation and consumption (commuting to work, business and shopping trips);

2.4. Communication and information linkages;

2.5. Relations resulting from other important sectors of the social reproduction that cause predominatly flows of persons (culture, entertainment and education, management, public health service and reproduction of labour, itc.).

It is the above relations around which the entire scope of territorial problems of concentration, specialization, and cooperations is focussed.

3. Effects that result from the relations and proportions between the territorial partial structures. Those latter may include proportions between the partial structure like production and science, population, resources, infrastruc-

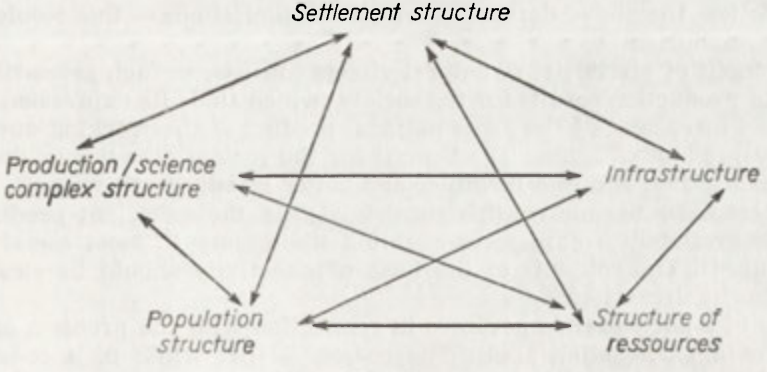


Fig. 1

tural facilities and settlement network. Such relations and proportions are developed in an entirely reciprocal way, and may be represented as on Figure 1.

The diagram shows that a large number of the above effects are directly related with the production, and may be represented by the corresponding values (eventually in monetary terms). Quite a portion of the above effects are, however, of non-economic nature, and can thus hardly be represented in a value form, while being partially unidentifiable in terms of quantities altogether. This strongly hampers such effects considered within the comprehensive effectivity calculation.

Territorial structural effects may be evaluated positively or negatively from the social point of view. One and the same form of territorial structure may lead to positive and negative results at the same time. (E.g., a high territorial concentration of the chemical industry may influence the production costs positively, while burdening the land with refuse at the same time). The individual effects may superimpose, reinforce or neutralize one another. This property of structural effects that makes an analysis of the effectivity very complicated has also been pointed out by R. Bönisch (1972).

This means, at the same time, that a knowledge of the territorial structural effects is not sufficient to permit an immediate and automatic determination of the effectivity.

A review of literature available in the GDR, as well as our own considerations, permit to present the problem of effectivity of the territorial structure.

The contents of the term covering the territorial effectivity has been defined by several authors more or less univocally (G. Ritzschke, 1967; R. Bönisch, H. Ostwald, 1971; R. Bönisch, 1972), as below:

The territorial effectivity is to be understood as total benefit, particularly the national economy benefit, as produced by a territorial management of social reproduction. The effectivity is the integrated expression of influencing factors acting upon social costs and effects.

The above definition points towards the fact that no full congruity has been obtained as to the contents of the terms of territorial structural effects and territorial effectivity. The term effectivity contains solely the benefit effects, and is predominantly economic-effect-oriented (owing to its being based on the cost-benefit relation). The cost-effects are given by an indirect reckoning (in the form of consideration of increased outlays to compensate for the losses which again reduce the benefit-effect), while effects of non-economic nature are occasionally pointed to (e.g., by G. Ritzschke, 1967 and R. Bönisch, 1972). In the sets of methods, on the other hand, as proposed for the determination of effectivity, the non-economic effects are hardly mentioned.

If to follow the above definition for all the limitations — this would lead to a further conclusion:

The benefit of territorial structural effects consists, in fact, primarily in the increase of production results for the society (which finds its expression particularly in the increment of the gross national product of the working output) and in other value index figures. The benefit for the society also lies in the expansion of leisure time and in a healthier and better standard of living (R. Bönisch, 1972). Apart from the above, this consists also in the sufficient production of goods and availability of services enabling the society to meet social and individual needs. The contents of the term of effectivity should be clearly conceived also in this sense.

This is of a particular importance in connection with the problem of the effectivity of agglomeration areas. The reason is that while in a consumption oriented benefit calculation one can still identify the expenses on the whole,

this would hardly be possible as concerns the results. This means, however, that, e.g., the benefit that results from the improvement of municipal traffic in agglomeration core can hardly be determined quantitatively, while the expense side would show amounts running frequently in millions and billions of Marks.

A further problem that results from the value-oriented effectivity determination has already been pointed to. It is derived from the fact that benefit values are based in the rule not on the territorial structural effects but on the structural effects as such. The latter include technological effects, economic sectoral effects, material input effects, power input effects, etc. It is for this reason extremely difficult, if not impossible, to determine the benefit effect of specific territorial structures in total. How far the territorial effectivity comparisons could be of assistance in this respect — should be examined first. The above state of things contributes to reduce the declarativeness of the territorial effectivity calculations considerably.

3. THE SPECIFIC CHARACTER OF TERRITORIAL STRUCTURAL EFFECTS AND THEIR IMPORTANCE IN THE CASE OF AGGLOMERATIONS

Agglomerations are of a particular importance in terms of territorial structural effects as fairly large parts of production and population are concentrated within such areas over a limited territory. Their economic potential determines the effectivity of the entire national economy. Particularly strong concentration of population — a product of concentration of production within agglomerations itself — is an essential impulse for the further development of the productivity and effectivity.

This circumastance has been particularly emphasized by K. Marx in his *Capital* in which he wrote:

"Just as a certain number of simultaneously employed labourers are the material pre-requisites for division of labour in manufacture, so are the number and density of the population, which here correspond to the agglomeration in one workshop, a necessary condition for the division of labour in society. Nevertheless, this density is more or less relative. A relatively thinly populated country, with well-developed means of communication, has a denser population than a more numerously populated country, with badly-developed means of communication; and in this sense the Northern States of the American Union, for instance, are more thickly populated than India" (Vol. I, pp. 345–346, George Allen and Unwin Ltd. 1946; reprinted from 1889 edition).

In this quotation the importance of the population, its density is emphasized. The latter in turn is determined essentially by the territorial concentration of commuters and by local infrastructure.

If we were to formulate a framework for the structure of the agglomerations which should fulfill the condition of territorial structural effects and a high effectivity, this would lead — on the basis of the heretofore results of work by the Section of Agglomerations, and of experiences gained from the literature — to the same points of view:

1. The most important basis is the high degree of territorial concentration of population, production, and technical infrastructure within the agglomerations. This results in the secondary effectivity factors (groups):

1.1. Numerous, in the rule highly skilled manpower locally available forming an environment that strongly favours specialized training, as well as gaining skill in a second and a third vocation. The present shortage of manpower within the agglomerations of the GDR does not speak against this factor of effectivity, but presents the result of the general population and

labour structure in the GDR, as well as of disproportions that were noted in the past between the demand for labour and the possibilities of this demand to be met.

1.2. The high concentration of production and services is determined at the same time by clearly outlined specialization and a broadly defined general profile. On this are based possibilities and real conditions of a well-developed cooperation between individual partners within a specific area. The above problems have been dealt with in detail by H. Schmidt (1971) as concerns the structure of industry of the agglomerations in the South of the GDR.

1.3. The qualitatively comprehensive and quantitatively highly concentrated technical infrastructure within the agglomerations enables a complex and full utilization of such facilities. The latest research by G. Kehrer (1971) on the example of the capital of the GDR has confirmed the above fact. The relation of investments in the technical infrastructure to those of the users (predominantly production units) shows an average value of 1:4 for all of Berlin, reaching 1:6 within the city core and showing a correspondingly lower value in the peripheral zone. An inverted increase shows that spendings on investments in the technical infrastructure per one inhabitant may grow to almost two and a half its value along the line from the city core towards the peripheral zone, though the city core involves 29 times as much value of investments in the technical infrastructure per 1 square kilometre.

A negative impact of a high concentration of population, production and infrastructure on the effectivity of agglomerations is noted wherever the local resources (which are not renovable or can be reproduced to but a limited degree) are claimed to a full extent. This applies mainly to area and water. This results in consequence ranging from a direct reduction in the effectivity of production to diminishing the recreational facilities of the population.

Apart from the above, one must also consider the strong territorial concentration of industrial waste materials occurring within the agglomerations. It has to be considered as a negative structural effect.

2. The fact that with high share of potentials of the agglomerations in the entire national economy such areas are closely tied with the remaining territories on the whole is of secondary importance. This is manifested by a very efficient public transportation systems; it offers the possibility to develop to an optimum also the other territorial relations beyond and between the agglomerations.

If to compare the above briefly outlined specific structure effects of the agglomerations from the angle of the cost-benefit aspect, they may be summarized in the following way:

1. An augmentation of the social benefit effect of the agglomerations as confronted with that of other territories is expressed by the following facts:

— higher or equal production returns at a lower cost as concerns comparable products and production standards. This does not have to be true of every individual production branch, but of production on the whole.

— A higher-than-average standard of provision of goods both with view to the quantity and quality of marketable products. (This is due to the concentration of high standard production equipment situated centrally in the cities of agglomerations. It is again the efficient transportation system that enables to serve a greater part of the population of areas in question than in other types of economic areas.)

— A higher-than-average income of the population in such areas.

The main factors of the increase of effectivity as quoted above should, of

course, be understood as complexes which may be further disaggregated. They may be used to depict the social benefit effect of agglomerations (as opposed to that of other territories), as on the average higher material and cultural way of life of the population.

2. Increased expenditures, and thus a reduction of the benefit effect within the agglomerations as confronted with other territories, result from the following:

— the frequently higher expenditure, in absolute and relative figures, involved in the utilization and reproduction of territorial resources, and partially in the technical infrastructure.

— Partially strongly increased expenditure involved in the management of production cooperation wherever this is necessitated by the more advanced concentration and specialization within an area, but difficult to arrange for.

— Increased spendings on the part of individuals and of the society, as concerns cost and time involved in commuting, increasing cost of meeting demand for services, educational and cultural facilities;

— Increased costs of refuse disposal as regards both the production and the population showing an upward trend within agglomerations, or of steps taken to increase the effectiveness of a district on the whole.

Should the attempts at a comparison of both those groups (benefit and expenditure) succeed, with the difference being determined, this would enable to calculate precisely the effectivity of agglomerations for the national economy.

4. CERTAIN COMMENTS ON THE POSSIBILITIES OF MEASUREMENT AND EVALUATION

The cost-benefit comparison as mentioned above is for the time being not possible as concerns agglomerations. Two problems representative in this respect, according to R. Bönisch (1972), are:

1. The benefit effect of agglomerations comprises components that can be evaluated from an economic angle, and those that cannot be evaluated from that angle. So far there is no basis for a joint treatment of the two;

2. Components to be evaluated by economic standards are not the result of territorial structural effects alone, but also of other structural effects. The problem of identifying territorial structural effects as concerns the effectivity of agglomerations, has not been solved yet.

This results in the general observation — which R. Bönisch has also rightly pointed out (1972) — that it is basically not possible today, and not advisable, to look for an expression of the benefit effect of agglomerations by a single criterion. Instead, it would be rather desirable to describe any given sector of the social reproduction process with the use of the most suitable criteria, and thus to develop step by step, an entirely new system of criteria and measurement values. Some interesting attempts have been recorded as concerns both entire complexes and parts of a territorial structure (thus, e.g., that by G. Ritzschke, 1967 who proposed a system of almost 40 criteria to deal with an entire complex of territorial effectivity, or by Lindau, 1968, concerning local economy expenditure, by a team of authors of *Ökonomisches Forschungsinstitut* 1968, concerning the resource economy, or by J. Heinzmann, 1971, concerning the effectivity of the structure of production).

All those permit — when proper data are available — to express the benefit effect for the national economy, of territories or within territories, wholly or partially in absolute figures.

Clearly enough, there remains the question how far may such figures be

deemed the representative of specific areas, and how far do they reflect normal, above — or below-the-average output conditions. In other words: the question still remains to be answered for the standard that would permit an assessment of such values from the territorial aspect. Such a standard is quite obviously not to be set in absolute figures. One cannot say: a certain area of structure *A*, or of type *A* is effective by national economy standards, while an area of structure *B* or of type *B* is not.

Hence, the statement that an evaluation of figures to measure effectivity may be carried out only by means of a comparison. To this end two basic possibilities are offered:

1. A territorial comparison

This is a normal measure used in geography, and known to be applied in two versions.

1.1. A comparison of a certain area with the average conditions prevailing in a certain country. Examples of consequent procedures of such type are presented in works by S. Leszczycki (1966) on the spatial structure of the national economy in the Polish People's Republic, or by E. Iwanicka-Lyra (1969) on the delimitation of large urban agglomerations in Poland.

1.2. As a comparison of various types of economic areas. As to the effectivity of agglomerations this would include above all a comparison of agglomerations with other types of areas (industrial areas of various type, agricultural areas, etc.), as well as a comparison with proportions between the parts of agglomerations, as well as of agglomerations one with another. The initial results in this respect are already at hand in the GDR (group of authors from *Ökonomisches Forschungsinstitut* — on questions of the territorial structures of gross national product, 1968; individual, unpublished research reports by the Section on Agglomerations on selected questions).

To assess the effectivity of agglomerations, territorial composition based on the above methods should take account of their most important feature, i.e., high spatial concentration as expressed in density exceeding average values. This means that an attempt must be made at referring the criteria of effectivity that have been found correct heretofore (like efficiency of labour, the size and intensity of infrastructural investments, also to spatial units, and to work out measurements for territorial productivity. This possibility has been pointed out some time ago by E. Neef (1961) in connection with the problems of central places (*Flächenzentralität*), and recently again by H. Roos (1971) in an unpublished discussion paper.

2. Apart from the territorial comparison there is a possibility of an evaluation of effectivity measures by time comparison. The rate of growth (G. Ritzschke, 1967, page 56 ff; R. Bönisch, 1972) is by all means suitable to render the development of effectivity of territorial structures fit for evaluation, both from the individual and complex angle. It should thus be expected that the agglomerations represent higher rates of growth than other territories. The combination of comparison of the time and area factor could eventually yield some relatively safe evaluation standards for individual absolute values. The above results may be summarized in the following way:

The assessing of the effectivity of territorial structures, and particularly in the case of agglomerations, presents an extremely important problem. The scientific approach to the problem is for the time being at its initial stage only. Attempts to solve this problem should be examined and evaluated through empirical research.

The Working Group on Agglomerations of the Geographical Department

of the Martin-Luther University at Halle–Wittenberg have been carrying studies on the above subject, particularly in respect to the effectivity of the production structure within the Halle–Leipzig agglomeration.

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DEVELOPMENT TRENDS IN THE INDUSTRIAL STRUCTURE OF URBAN AGGLOMERATIONS IN THE GDR

HELGA SCHMIDT

The search for an optimal concentration of production occupies a significant position among the problems of development of the territorial structure of urban agglomerations in the GDR.

The aim is to find and work out ways and alternatives within the proportional development of the national economy on the whole, to contribute to the planned development of optimum conditions for working and life.

Problems of the territorial industrial structure are a domain of a relatively young branch of science. Notwithstanding this fact, many analytical efforts concerning these problems have been made during the recent years in many industrial countries. Still, it is striking that only few studies are devoted to such long-term development trends as those triggered within the industrial structure by the technological-and-scientific revolution. This is particularly true of studies originating from the capitalist countries. In those latter, questions pertaining to the territorial division and management of the industry are usually treated marginally, or approached almost entirely from the angle of land utilization or of city planning. Those discussions reflect the capitalist production conditions and their applicability is limited to a particular social system. This is why they can hardly constitute a basis for solving the problems of territorial structure in the socialist system. The scope of problems involved in a rational territorial management of manpower presents an essential research gravity point in the socialist countries.

It is the Soviet authors who concentrate particularly on such questions. The scientific achievements concerned with the territorial structure of the industry are, however, due to different natural and historical conditions only to a limited degree applicable to the GDR.

The historical development led to a non-uniform territorial arrangement of the social production. Concentration within the four agglomerations of the GDR which cover only 15.2% of the entire territory, involves 50% of all fixed assets in industry and approximately 50% of the entire industrial production. At the same time, there are regional differences in the industrial development within the agglomerations. Such disproportions within the agglomerations have been taken over from the capitalist system. They are manifested particularly in the disharmonious development of working and dwelling areas, in heavy burden put on the existing infrastructure and on the local natural resources. It is the goal under the socialist production conditions to overcome those problems in a planned way within the coming years. As concerns the answers to questions involved in prognoses for the development of the production structure, we shall outline several basic problems:

1) General conditions and trends in the development of highly effective industrial structure, including the shaping of new industrial location factors.

2) Problems involved in the inner differentiation and improvements of the production structure in the agglomerations.

GENERAL CONDITIONS AND TRENDS IN THE DEVELOPMENT OF HIGHLY EFFECTIVE INDUSTRIAL STRUCTURE

The conditions imposed by the scientific-and-technological revolution will cause qualitative and quantitative changes in the industrial structure of the agglomerations in the GDR. It is above all the non-uniform growth of the individual industrial branches that triggers changes in the territorial structure.

The high regional flexibility of production of the agglomerations proves particularly favourable. The growth of industry is effected generally speaking by the following territorial aspects:

— the process of territorial structural changes of the industry;
— the process of the territorial division of labour;
— the process of concentration within the local infrastructure and within the settlement network;
— the most rational use of local resources and the possibly highest standard of their reproduction.

Under such conditions the following general territorial trends in the development of a highly efficient industrial structure can be noted:

1) The progressing integration of science within the process of the national economic growth and reproduction. This is visible in the trends towards placing industrial and scientific-and-technological establishments closer to each other, as well as in the fact that the latter assumes the forms of important elements of territorial structure (e.g. large-scale research centres in the agglomeration cores);

2) The scattered and un-economic territorial arrangement of industry must be converted step by step, into rational forms. That most essential task consist in the development of more efficient forms of the territorial labour division and cooperation. This involves a persistent specialization of industry to overcome non-economical, redundant production activities, to limit production assortments, to develop establishments with a higher working capacity at one place or within one economic area, to erect higher-capacity integrated works and to promote integration and cooperation on the national or international scale;

3) Overcoming the strongly dispersed production profiles and territorial specialization should not lead to a one-sided structure. Instead, the degree of complexity of the areas in question must be increased. This involves above all an expansion of the local production interrelations, and effective use of local natural resources. At the same time, a high efficiency of territorial production management must be aimed at;

4) The development of the social labour potential in the GDR demands rational manpower management in the structure-shaping branches. Generally speaking, however, the growth of employment in such branches must be strictly controlled with overbridging the gap between the manpower demand and reserves in mind. The controversy between the development of labour capacities and the number of jobs offered is to be levelled-off step by step, with the assistance of the socialist movement of technical improvements and automation. This means that expansion of the existing plants or building new ones in the agglomerations is possible only under conditions of a high degree of mechaniza-

tion and automation. The territorial arrangement of industrial capacities must be put in line with the growth of the social labour potential;

5) The same can bt said in relation to further shortage of territorial resources, above all of land and water. It may be observed that the dependence of the production site on the availability of resources may be limited or changed due to the application of modern technology;

6) The same applies basically to the local infrastructure. Its concentration may influence favourably the spatial organization of industry. This means above all reduction in the land requirement;

7) The intensive or extensive industrial development should be connected with the concentration processes within the settlement network. This can reduce the special territorial costs while carrying the program of territorial development.

Apart from the above general trends, the scientific-and-technological development till and after 1980 will be of an essential impact on the spatial distribution of industry. The rapid growth of new technologies is reflected, i.a., in the automation of the entire manufacturing processes, in the development of new raw materials, in the intensification of the traffic network over time and space, in the automatic dispatch of crude oil, natural gas, water and electric power over long distances. This makes thinking over the entire complex of industrial plant location a necessity. Apart from those considerations as concerns the development of the industrial structure of agglomerations in the GDR, like the raw materials supply, transportation, labour, etc. new location factors will gain greater importance (Fig. 1):

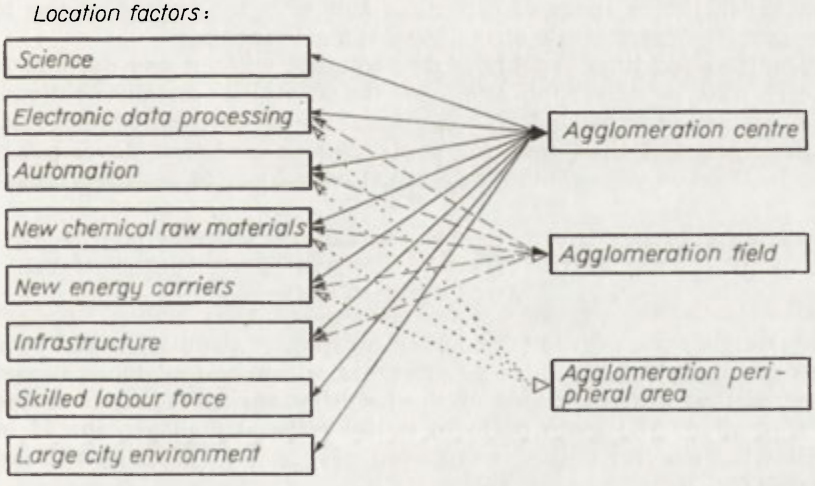

Fig. 1. New location factors of industry in the sub-structures of the system "Agglomeration"

1) The progressing integration of industry and of scientific establishments, as well as the EPD-capacities;
2) The progressive automation;
3) The introduction of new production materials;
4) The structural changes in the power supply;
5) Alterations of the infrastructure;
6) The growing requirements in terms of labour skill;

7) The growing attractiveness of the "large city environment" within which to promote the socialist working and living standards.

The knowledge and awareness of those new location factors allows for more efficient and rational assignement of production branches, commodity groups and main products within the agglomerations.

Major requirements as concerned with the development of industrial structure of the agglomerations result from intense expansion of the overwhelming majority of sectors and branches. This means that the growth of production must be obtained by increasing labour effectivity, i.e., essentially by complex socialist rationalization movement. The development of structure-shaping branches will follow the road of an intensely rather than extensively expanding reproduction. Extensive in this case means an increased use of the territorial resources, particularly of land and water. Territorial reserves of manpower must, however, be made available by rationalization within the branch in question or within the particular area. An extensive development also involves an increasing demand as concerns infrastructure. Due to the heavy demand put on the local resources and infrastructure in the agglomerations an extensive development should be reserved essentially for those branches where contacts with science are most essential.

The development of individual branches and lines in various agglomerations must follow their importance for the national economy and their contribution to the production totals of the given agglomeration. With the demand put on the local resources as the starting point, the branches may be assigned to three principal groups:

1) Branches and lines noted for a dynamic or an extensive development, i.e., for expansion in space of capacities and with the supply of the local resources involved (part of the structure-shaping branches);

2) Branches and lines capable of development without any demand for local resources, due to the application of the complex socialist rationalization methods by way of expanded reproduction (branches typical of particular area);

3) Branches and lines that for a planned proportional development must rely on local resources or, otherwise, must be subject to restructuralization.

PROBLEMS INVOLVED IN THE INNER DIFFERENTIATION AND IMPROVEMENTS OF THE PRODUCTION STRUCTURE IN THE AGGLOMERATIONS

Depending on the degree of the concentration of population and production, one can distinguish three types of sub-areas within the agglomerations. It can be assumed that growth trends of the industry are spreading over the entire area in question. The main problem is the rational management of industry. The following general outline have been proposed to describe the individual sub-areas (Fig. 2).

The agglomeration centre or core represents the strongest local concentration. It comprises the densely built-up town and its suburban zone. The positive structural effects of the agglomeration are shown here as concentrated over a restricted area. This results in the possibility and the necessity to make use (by direct and multilateral contacts) of the close interrelations between production, science and education, of the proximity of the places of residence and work as well as of cultural and social facilities, for the development of optimum working and living conditions.

From the industrial development angel an agglomeration centre represents such production branches which require close contact between science, produc-

tion, and skilled manpower. Hence, the aim is to provide within the agglomeration centre those production branches which involve a high degree of specialization and modern technology. This requires the development of dynamic industrial branches, as well as the overcoming of still often existing scattering of production capacities by a pronounced concentration at the level of a plant or industrial branch. This demands an increase of the degree of the complexity of science and production, as this forms the basis for a high standard of availability and flexibility of production, while permitting structural changes to be

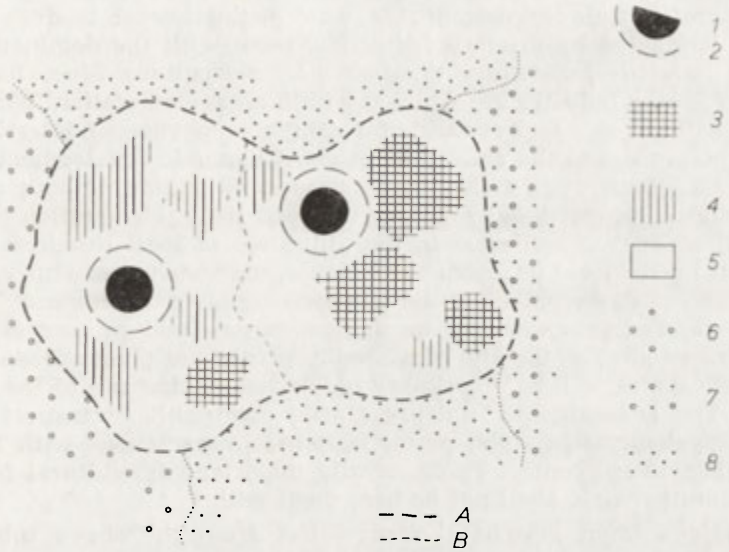

Fig. 2. A model of the system: "Agglomeration–Agglomeration peripheral area"

Structure	*Function*
1. Central (core) city	Agglomeration centre
2. Suburban zone	
3. Type FP — large industrial complexes with dominance of primary industry	Agglomeration field
4. Type FI — areas of industrial concentration of medium and small plants with dominance of processing industry	
5. Type FA — agricultural areas with industry of secondary importance	
6. Type PI — peripheral zones of specific pattern of industry	Agglomeration peripheral area
7. Type PM — peripheral areas with mixed structure and no dominant economic branch	
8. Type PA — peripheral agricultural areas	

A — boundary between agglomeration and peripheral area
B — boundary between zones of influence of two agglomeration centres

effected with the higher economic results obtained, at smallest cost possible. An attempt at modelling the industrial structure of an agglomeration must be viewed together with the development of territorial labour division. On the basis of the complex socialist rationalization and the automation of production, the agglomeration centre developes as a centre of scientific-and-technological controls and the industrial production management, as well as a concentration of those industrial establishments (both research and development units and final goods producers) which require close interaction with scientific institutions. Such a function requires conditions already represented by the majority

of agglomeration centres. Those include possible advantages of contact with and information inputs from the scientific-and-technological research centres and the planning-and-management centres. Further they include access to efficient transformation systems, sufficient manpower, availability of land for production purposes (at least in sub-urban zone), possibilities of local cooperation and coordination between production units in supplying standardized parts and components, etc.

An agglomeration field is noted for a relatively dense network of production sites of various size and structure. From the angle of the production structure the agglomeration field is not homogeneous. A distinction can be drawn between sub-areas dominated by primary industries, those with the domination of the processing industries, and those dominated by agriculture. Since the primary and the processing industry are situated within an agglomeration field in manifold combinations, this fact accounts for a high proportion of interrelations of industrial plants within the area in question. A dynamic development of a sub-area of an agglomeration field necessitates an expansion of both qualitative and quantitative proportional relations between the agglomeration centre and its field. This can be manifested in the utilization of local resources or in the demand put on the local infrastructure. Hence, the conclusion with view to the determination of development of the territorial industrial structure. This tends towards further development of an agglomeration field in contact with the agglomeration centre as the site of assembly plants and plants producing parts and components, as well as of primary industries making use of the capacities available. The generally satisfactory traffic and public transport facilities within an agglomeration field, permit rational interrelations with the plants of the agglomeration centre. The generally important agricultural function of the agglomeration field shall not be here dealt with.

The agglomeration peripheral areas differ from the above sub-areas by a low degree of spatial concentration in all sectors of economy. Also in this case one can distinguish between subareas of various nature from the angle of the production structure, e.g., peripheral zones with relatively independent profile marked by the industrial production, peripheral zones of a mixed structure, with no pronounced domination of a single branch of economy, and peripheral zones with agriculture predominant.

The peripheral zone of the agglomeration maintain varying territorial ties with the agglomeration centre and to the agglomeration field. The prerequisites for the further development of the former also vary depending on the type of an agglomeration area. Peripheral zones which are not specialized and therefore are showing an extensive range of production within the light, foodstuffs processing and metal working industries, form a potential area for the expansion of initial stages of production, tied to plants located within the agglomeration centre and agglomeration field. Peripheral zones may furthermore relieve the strongly concentrated sub-areas of the agglomeration. This is due to the availability of manpower, of land and of their favourable situation in relation to the transportation system (Figs. 3 and 4).

Apart from a more rational organization of production management within an agglomeration, the growing territorial labour division results in the advancing interrelations between the agglomerations. It is to be estimated that the agglomerations in the south of the GDR will tend to interrelate and form overlapping zones due to growing production ties. A diversified production structure and a great variety of auxiliary production being typical of the agglomerations follows in multilateral cooperation possibilities for a rational production mana-

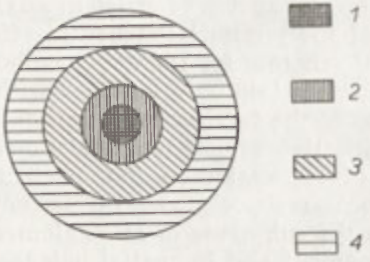

Fig. 3. A model of the development of territorial division of labour within the system "Agglomeration"

Function	*Spatial sub-structure*	
1. Scientific and technological management organizations, data processing centres	Central (core) city	Agglomeration centre
2. Production of semi-finished and final goods	Suburban zone	
3. Preparation and assembly of construction elements	Agglomeration field	
4. Preparation of standardized parts and components	Agglomeration peripheral area	

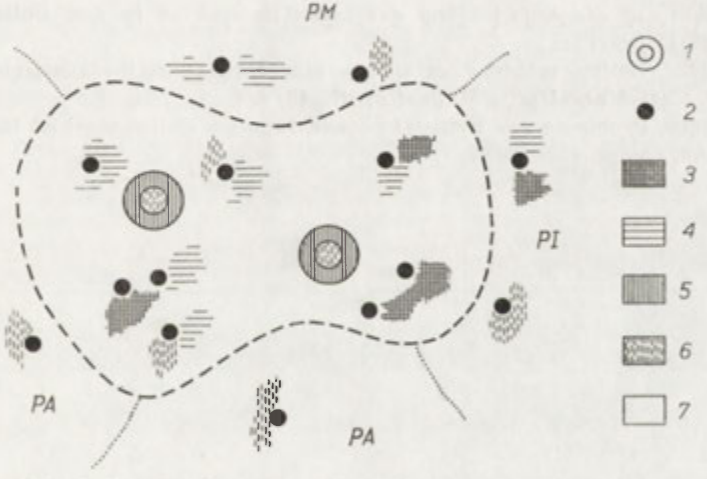

Fig. 4. A model of the development of production structure within the system "Agglomeration"

1 — Agglomeration centre, 2 — groupings of industry (mostly county capitals), 3 — primary industry, 4 — engineering industry, 5 — processing industry, 6 — light and food industry, 7 — agriculture

Boundary	*Spatial sub-structure*	
———	Central (core) city	Groupings of light industry
	Suburban zone	Areas of concentration of processing industry
— — — —	Agglomeration field	Areas of concentration of primary and engineering industry
. . . . .	Agglomeration peripheral area	Groupings of light, foot and engineering industry

gement, particularly for the expansion of efficient auxiliary industries resulting in an essential increase of the territorial structure effects.

The implementation of schemes for the development of the industrial structure as presented above, is possible only together with a proportional development of all sub-structures of the territory in question. This is also true of both qualitative and the quantitative proportional relations that must be developed between the sub-areas of an agglomeration, particularly with view to the rational utilization of local resources and infrastructure. If the question of proper relations between the sub-areas of an agglomeration is disregarded disproportions in the development and in spatial balance may result.

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THE DYNAMICS OF URBANIZED ZONES FORMATION: METHODS OF SOCIO-OCCUPATIONAL STRUCTURE ANALYSIS. CASE STUDY OF THE UPPER-SILESIAN INDUSTRIAL DISTRICT

Jan Rajman

GENERAL ASSUMPTIONS

The industrial potential of urban centres and local industrial concentrations plays a leading role in the forming of urbanization processes in large industrial districts. It is expressed by the activity of more or less active "leading units". The influence of these units on others is due to their activity or because they are part of the areas major form of activity. (F. Perroux, 1950, p. 257). A city, apart from its size and place in the settlement network is a collection of factories and institutions whose interdependencies and specialization form its functional character. The economic potential of the cities — built up as a result of industrialization and investments of the socialist economy — is a major factor in the process of transforming them from central places (where services functions were dominant) into important regional centres of economic growth (S. Leszczycki, P. Eberhardt, S. Herman, 1971a, p. 38).

The growing need for labor power during the period of socialist industrialization, which cannot be satisfied by the city population alone, causes that ever-wider parts of the cities and industrial centres are plunged into the rhythm of socio-economic changes. They are therefore an especially good area for observing newly rising socio-economic structures. The base of the mentioned changes is a progressive specialization of the social and territorial division of labour which in turn leads to a formation of the new arrangements of spatial employment structures, of settlement and production complexes and urbanized zones.

Attempts made by some western sociologists and planners of conceiving the evolution of the spatial structures of cities and their spheres of influence as theoretical geometric arrangements of the annular or cuneiform type (W. Burgess, 1925; H. Hoyt 1939–43; E. Gloeden, 1923) do not give the full picture (M. Dobrowolska, 1964, p. 120). Being based on development processes typical of the capitalistic formation they cannot be fully generalised.

The basic assumption of the undertaken studies on urbanization processes is to confirm that the old model ideas of the settlement network are outdated (for ex. W. Christaller's central place theory). An interdependent arrangement of cities as the result of their spatial competition is replaced by the being newly formed, under the influence of new investments, system of cities — in other words — interdependent arrangements based on a territorial, social and functional division of labour. Having these assumptions in mind we aim at distinguishing in detail the specific structural features or spatial dependencies

within the mentioned settlement systems which might in turn lead to the verification of hypothesis, newly formed in Polish geographical literature, in the theory of human settlement (K. Dziewoński, 1971a, p. 109).

The knowledge of the mechanism of urbanization processes of Poland's largest urban-industrial agglomeration which arose around the Upper-Silesian Industrial District may have an important meaning as far as modelling is concerned for the future large industrial areas of the country. Even today 43.3% of Poland's urban population live in large cities, while the so-called "urban complexes" as defined by the Central Statistical Office including cities with over 100,000 inhabitants comprise 51.2% of total number of urban dwellers. Thus one of the main tasks in the field of settlement problems are studies aiming at the simulation of the mechanism of urban agglomeration growth and leading to an establishment of optimal models of urbanized regions (J. Goryński, 1967, p. 48).

METHODICAL BASIS

1. Our reflections upon the urban-industrial agglomeration of Upper-Silesia have their starting point in the following statements:

a) spatial development of all forms of settlement expresses the social division of labour; the influence of the geographical environment as a stable and indispensable (but not decisive) factor being of second-rate importance for their development;

b) the development of settlement forms is governed by economic laws, related to given socio-economic formations;

c) the settlement network transformed under the influence of industrialization, consists of interdependent settlement arrangements, representing different types and development phases;

d) settlement patterns of the urban-industrial agglomeration type are one of the alternative forms of the evolution of settlement networks in Poland. At the same time, as S. Leszczycki (1971, pp. 14–15) points out, there is a tendency of forming axial patterns or possibly locating new investments in already developed centres.

It should be noted, that in the analysis of settlement patterns of the agglomeration type a large role may be played by methods taken from cybernetics, which aim, as it is well known, at defining the functioning mechanism of a relatively isolated system (H. Greniewski, 1959, p. 11). From the point of view of the nomenclature of cybernetics all agglomerations may be treated as relatively isolated systems under the influence of a feedback. Feedbacks of a different kind are so-called regional-urban advantages, defined by W. Isard (1965, p. 258). The influence of these advantages, that is positive feedbacks may at least be partly grasped, in case of a large regions with the help of the model of the potential of relative income (W. Isard, 1965, p. 528).

But other methods must be used in order to obtain knowledge of the inner structure of the urban-industrial agglomeration, for the use of the deterministical gravity model is not recommended in this case. A developed mathematical model should be treated as an empirical generalization with a different degree of universality and thus constitute a contribution to theory building. (Z. Chojnicki, 1966, p. 16). But in the mechanism of forming the urban processes of large industrial districts a far too great a role is played by different endo- and egzogenic factors, which should be classified as random variables as depicted in the classical approach to probabilistic models (Z. Pawłowski, 1963, p. 18).

Team studies of urban processes of different regions in southern Poland (M. Dobrowolska, 1962, 1967) made it possible to formulate the following hypotheses:

The basic element which influences the spatial structure of the urban-industrial agglomeration is the system of relations consisting of the given industrial plant and the places of residence of its employees. The technical and social infrastructure, connected with this system is in relation to the industrial unit, of secondary importance. The role of a single element, in the meaning suggested above, is influenced by the function played by a given plant in the structure of the whole agglomeration (or even in the region, macro-region or country), as a unit of reference. The method of identifying this function, for example by way of measuring the urban economic base (K. Dziewoński, M. Jerczyński, 1971, p. 55) is one of the more important research postulates in the empirical studies of large urban industrial districts.

According to the theory of production concentration (K. Dziewoński, 1948) every urban-industrial agglomeration has a certain measure of attractiveness to individuals which find themselves near it due to the fact that it concentrates a certain number of units and places of employment. A growth in the number of jobs available makes the place more attractive, bringing in, thus, more people. In the urban agglomeration positive feedbacks occur until a certain level of development is reached above which there take place negative effects, that is feedbacks of the negative value. Thus, while studying urban-industrial agglomerations it is important to recognise their respective development thresholds (B. Malisz, 1963, p. 271). A hypothesis may be formulated that in the sphere of urban research these thresholds are:

a) reaching a certain housing capacity, measured in building density and population density per dwelling;

b) exhaustion of local labour force reserves and the existance of labour force shortages on the non-agricultural labour market which might in consequence lead to immigration from often distant regions. A different situation may also arise in a given city, when supply exceeds demand. Then a job shortage will constitute the development threshold and in consequence — a substantial outflow of the population to more attractive areas.

c) failure to maintain the urban and industrial investment standards, which causes burdensome living, conditions, degradation of the geographical environment, and, as a consequence centrifugal migratory movements of the population.

In the case of a simultaneous existence of thresholds (a) and (c) is a need to make decisions about the deglomeration of an industrial district (see Regional Plan of the Upper-Silesian Industrial District for 1953, M. Grabania, 1964, pp. 12–13).

2) The separation, in research studies, of the idea of large urban-industrial districts from the administrative notion of "city" and replacing it by the notion of "settlement system", "urbanized area" or "urban-industrial agglomeration" forces us to reorganize our research methods. Thus we must pas from studies of localized points (cities as points in the geographical and socio-economic space), for which it was easier to obtain statistical information, to studies of areal patterns — zones and clusters — often of considerable size (urbanied zones, urbanized regions, Megalopolis). Unfortunatelly the official statistics does not offer much data on these territorial systems. Thus including the smallest units of the administrative or even economic division (institutions, factories) into research studies causes additional methodical difficulties.

In order to present the inner differentiations or functional relations within

the *a priori* defined complexes, zones or whole agglomerations, necessary information has to be gathered almost exclusively by way of fields work. Data obtained from general population censuses (hold every 10 years) are not sufficient since the situation changes too rapidly. A big role in this research work may be played by team work, for which however there must be prepared a detailed and long-range research programme.

The importance of field work in the study of large urban-industrial agglomerations is due to the fact that, besides that it allows for the obtaining of the statistical materials, it also makes possible a direct contact with the object study. This contact allows for the making of working hypothesis and for an empirical check of the resarch assumptions. Also, a first-hand knowledge of the studied area prevents against making hasty generalizations on certain phenomena. A theoretical generalization, based on deductional analysis should take into consideration spatial differences, the manifoldedness of which is the essence of geo-economic phenomena (M. Dobrowolska, 1967, p. 9). Knowledge of these differences has an exceptional meaning in studies concerning the methodology of planning settlement systems. The process of their formation, although it must be based on a coordinated planning system, is greatly complicated in the social aspect. Thus it cannot be presented only in formalized schemes or generally depicted in an economic calculus (B. Malisz, 1963, p. 296).

In this paper, methods of analysis of administrative units (points patterns) and areal patterns (employment systems, urbanized zones) have been combined. Detailed criteria of the delimination of these systems ware presented on examples taken from the Upper-Silesian Industrial District.

The basic research assumption of the presented studies on the dynamics of urbanized zones formation was the combining of micro-analitic research methods with a macroscope interpretation of the spatial structure of the region. Like every economic region, the urban-industrial agglomeration of Upper-Silesia is made-up of a certain number of interrelated different socio-economic elements. One of the main phases of the research procedure outlined was to bring out the meaning and the role of these elements in the growth process. The changeability of relations between socio-economic components, which may be defined as elementary spaces of urban-industrial agglomerations (R. Domański, 1970, p. 54) can be studied with the use of different methods. Having in mind the Marxist idea of a city as an evolutional form connected with progressing social division of labour (W. Kula, 1951, p. 14; B. Malisz, 1966, p. 37) we view it (as well as an urban agglomeration) as a collection of factories and service institutions, which together with their labour force potential determine its economic base. Thus, the research method of economic urbanization processes is based on an analysis of changes in the employment structure in connection with the volume and specific characteristics of an urban labour market as well as the need for local and non-local labour force. Difficulties in securing detailed statistical data necessitate field work in which a plant or an institution, is the smallest unit under research. The reconstruction of it's role in shaping its own settlement pattern leads us to an analysis of employment complexes and urbanized zones.

UPPER-SILESIAN URBAN-INDUSTRIAL AGGLOMERATION AS A STUDY AREA

The Upper-Silesian urban-industrial agglomeration, though with often differently defined boundaries, was already the subject of a number of geographical economic studies (S. Leszczycki, 1959; A. Wrzosek, 1964, 1967; N. J. Pounds, 1958 and others). Although these studies gave us a better knowledge of the de-

velopment of its industrial potential, they did not sufficiently concentrate on the changes in the settlement network and settlement patterns beyond the central conurbation area. Thus an attempt has been made in this paper to discuss the subject, making use of the author's own studies as well as of team work performed at the Institute of Geography of the College of Pedagogy in Cracow (M. Dobrowolska, 1959, 1964).

1. DIFFERENTIATION OF THE SOCIO-ECONOMIC STRUCTURE

The northern part of Upper-Silesian Coal Basin consists of a group of mining and industrial cities forming a conurbation. This pattern is the result of mining activities (coal, iron and zinc ore), which started at the end of the 18th century, as well as of the development of manufacturing. The Upper-Silesian conurbation, the development of which took place until World War I within different states (that of Prussia and Russia; later, during the inter-war period it was divided by the Polish-German border) has a complicated socio-economic structure.

The main characteristic of the conurbation, which makes it unlike other large Polish urban agglomerations is a very high population concentration measured in absolute figures (1603,9 thousands in 1970), as well as in population density per square unit (2620 persons per km^2). Thus, we notice that an area that represents 0.2% of Poland is inhabited by 4.9% of Poland's population. The spatial structure of the conurbation is characterized, on the one hand, by a great density of industrial and service units (nearly 790,000 persons work in socialized economy) and on the other hand, by a specific settlement pattern in which urban formes mix with rural forms. Production and functional relations as well as administrative decisions were the factors that transformed individual mining, steel-making or factory settlements into large cities.

A characteristic of this settlement pattern is an non-uniform functional and size structure of its elements. Katowice (city) with 303.7 thousand inhabitants (in 1970) are nine times larger than Czeladź (32.0 thousand inhabitants), the conurbation's smallest town. Disproportions in population density are not so large (1513 persons per km^2 in Mysłowice and 4494 persons per km^2 in Chorzów — Poland's most densely populated city) due to a similar use of space based on a dominant urban-industrial utilization of land. A very advanced degradation of the geographical environment is a consequence of the dynamically developing Upper-Silesian industry (A. Wrona, B. Zemła, 1971, p. 365 ff.).

Individual urban-industrial centres, which developed through use of local energy and mineral base, and have been linked by technical and partly social infrastructure, show presently, due to a planned economic feedback, characteristics typical of component units of a conurbation (K. Dziewoński, 1962). Although within the conurbations limits there are still rural areas (pastures comprise presently 28,8% of the total area) agriculture is of secondary importance.

Although the Upper-Silesian conurbation is not yet an uniform economic and administrative unit, multiple transportation links between all of its elements make it easy to utilize a vast number of services and functions thus contributing to the formation of a supra-regional organism bearing the characteristics of a metropolitan centre. The long-term plan (till 1980) assumes the formation of a big, inter-connected urban region which will comprise 30 cities of the Upper-Silesian and Dąbrowa Coal Basins.

Around the Upper-Silesian mining and industrial conurbation, which should be treated as the nucleus of a greater agglomeration, there sprang up other economic sub-districts functionally connected to the central area. Through they differ in size, mineral base, economic profile and in the degree of urbanization,

they form subsequent zones of the urban-industrial agglomeration which from in turn a central part of the Silesian-Cracow Industrial Region (T. Mrzygłód, 1962, p. 118). This whole region which extends over the Silesian Upland, Cracow–Częstochowa Plateau, Beskid Mountains and their Piedmont areas and the Odra river valley, shows great spatial contrasts which are a result of economic and historical development.

Within immediate neighbourhood of the Upper-Silesian conurbations there sprang up a number of smaller industrial centres and clusters which together with the local housing areas come close to the notion of an "urbanized zone" as interpreted by O. Boustedt (1960) in his concept of an urban region. Within the subsequent zones of the Upper-Silesian agglomeration there arose further economic sub-districts:

a) those created on the bases of coal mining and supporting industries (Rybnik Basin, Chrzanów–Jaworzno Basin);

b) those erected on networks of medieval towns with craftsmanship traditions and a late-feudal centres of wood, foundry, metal, mineral and textile industries and developed as a part of the national economic development plan (Bielsko Industrial District, Częstochowa Industrial District, Upper-Odra Industrial District, partly also centres of the western part of the Cracow Industrial District like Chrzanów, Olkusz, Oświęcim).

2. EMPLOYMENT COMPLEXES AS MAJOR ELEMENTS OF THE SPATIAL STRUCTURE

The investigations carried on in the Upper-Silesian conurbation and its marginal zones have revealed the existence of settlement and employment complexes, at various stages of development, namely:

a) settlement complexes made up of a given industrial plant and workers homes and peasant-workers farms situated in one or more villages;

b) complexes treated as a result of the impact of an industrial centre or duster on a rural area;

c) urbanized zones, developed as a result of linkages between several or more neighbouring, but also competitive in space, urban-industrial centres.

The spatial extent of these settlement complexes has been determined on the basis of employment links taking also into consideration a wide range of existing functional and service relations. This spatial extent may be considered as an important delimitation criterion of the urban-industrial agglomeration, or at least these parts, which together with the core should be covered by a single local plan.

In studies conducted by this author, or under his direction in several centres of the agglomeration there has been noticed a characteristic phenomena of mixing of various types of settlement complexes. This phenomena is a result of an excessive concentration of industrial and service units on a relatively small area. Specific plants with various needs for labour force, include into their sphere of influence several or few dozen villages. Thus, it is difficult to talk about a settlement complex which is the result of solely daily home-to-work commutation (B. Malisz, 1966, p. 37). When it comes to defining it, we must additionally take into consideration quantitative criteria concerning these relations which are dependant on type of industry as well as the location of a plant in a given socio-economic space.

Coal mines and transportation and building enterprises show the greatest demand for non-local labour force. In extreme cases the percentage of commuter workers is as high as 75% (the following mines for example: "Brzeszcze", "Komuna Paryska", "Siersza", in the Jaworzno Basin). Since these plants are located in the Upper-Silesian conurbation or in developing centres of marginal

sub-regions, they seldomely develop their own settlement complexes. A big competition on the non-agricultural labour market, where demand often exceeds supply forces the mentioned plants to look for employees in distant areas. Thus the places of residence of their employees are dispersed over a vast area. Field work conducted by J. Herma (1962, 1966) in a number of industrial centres in the western part of the Cracow voivodship pointed that the range of commutation (based mostly on trains and factory buses) is highly diverse. In some cases the length of commuter trips exceeds 100 km, and employees of certain plants or mines may live in several tens (even 230 — "Brzeszcze" mine) of villages.

Heavy commutation is a characteristic feature of every construction site; be it a city or a factory. This phenomenon has been observed in the Rybnik Coal Basin. It is due to a large demand for unqualified labour. Once the factory or given housing district is completed the number of commuters rapidly decreases; this particularly applies to long-distance commuting. This means that in order to delineate the labour field for a given factory, one must not only determine the place of residence of its employees but also consider the proper period of research. It is one of the principal postulates in the study of settlement complexes based on employment linkages.

In urban-industrial centres of Upper Silesia a different type of competition has also been observed on the labour market; namely a part of workers belonging to one plant are being seized by others. As a rule this takes place when a new plant offering better wages and working conditions is opened. Such was the case with the newly opened "Staszic" coal mine in Katowice-Szopienice when a part of the crew decided to leave the old "Wieczorek" mine situated in the same quarter of Katowice. A similar process, but on a much larger scale, may be observed in the Rybnik Basin. As consequence the spatial links of many plants as well as their internal structure of employment change.

A characteristic feature of social and territorial division of labour in the urban-industrial agglomeration of Upper-Silesia is the overlapping of the influence spheres of particular plants. The result of this phenomenon, genetically connected with the previously mentioned specific demand for manpower as well as the competitive role of urban and local production centres, is growing complexity of settlement patterns. This system of linkages can no longer be interpreted in terms of a simple hierarchical network of urban places. Employment linkages lead to settlement systems where particular villages, settlements and cities occupy a definite position determined by progressing social and territorial division of labour.

3. CRITERIA OF DETERMINING NON-AGRICULTURAL EMPLOYMENT COMPLEXES

In an attempt to show the mechanism of urbanization processes of rural hinterland surrounding the urban-industrial centres of the Upper Silesian agglomeration, all cities where the number of employees in both industry and services exceeded 10,000 were subject to detailed analysis. The point of departure was the reconstruction of daily commutation patterns on the basis of the employment structure of rural population. This allowed to determine the range of employment complexes for particular plants and employment centres.

Into those complexes, constituting parts of urbanized zones, are included, apart from the main urban centre, all those communes in which urban occupations accounted for more than 40% in respect to professionally active population. Applying the intensity of linkages as a criterion, three zones have been distinguished within the complexes. In general they correspond to subsequent

rings in Boustedt's model of an urban region.

a) urban zone grouping communes where 70% of the professionally active population is in non-agricultural occupations and over 30% commutes to a central city;

b) closer border zones (50% outside agriculture and over 15% employed in urban centre);

c) farther border zone (40% outside agriculture and over 10% employed in urban centre).

The above mentioned criteria differ from delimitation principles applied by S. Leszczycki, P. Eberhardt and S. Herman since they concern employment structure rather than occupational structure of rural population. The aim of this approach was not only to delimit the boundaries of urban-industrial agglomerations but also to reconstruct their internal differentiation.

Applying the above mentioned criteria 22 non-agricultural employment complexes have been delimited within the marginal zones of the Upper Silesian Industrial District. They represent various stages of development: from simple complexes comprising a town and a few neighbour villages (eg. around the textile metal centre of Andrychów, mining centre of Knurów, *poviat* centre of Żywiec, to a fully shaped urban region around the textile-machinery centre of Bielsko-Biała.

It is to emphasize that only in 9 out of all the delimitated complexes did all the spheres of influence develop. Another characteristic feature is the overlapping of individual complexes leading to the formation of very intricate settlement patterns. The delimitated complexes differ considerably as to the degree of professional activity and non-agricultural occupations of their residents. The percentage of those working outside agriculture ranges from 67.3% in the Żywiec complex including several urbanized mountain villages, to 92% in the direct neighbourhood of the Jaworzno mining-energy producing centre. It is to be assumed that those complexes created under the influence of Upper-Silesian conurbation, which were not subject of comparative analysis, have an equally high level of "urban" occupations.

This level is higher in mining basins and complexes formed by large urban-industrial centres like Bielsko-Biała, and Częstochowa, than in those situated in the Southern and Western margin of the Upper-Silesian agglomeration. The first group includes communes where 60–80% of the professionally active residents work outside agriculture (the modal value being 68,2% for mining complexes and 79% for the complexes formed by the largest centres of the marginal zone of the Upper-Silesian Industrial District).

The second group is dominated by communes with 40–60% of non-agricultural occupations (the modal value being 45.7%). The contribution of urbanized communes (80% outside agriculture) is also higher in mining basins. This points indirectly to the leading role of coal mining in the urbanization processes of the Upper-Silesian Industrial District.

A characteristic element of almost all employment complexes is their structural differentiation. Each complex contains a number of local gravitation patterns related with the production profile of local plants. They represent elementary and simple settlement patterns (B. Malisz, 1966, p. 51) and constitute a characteristic component of the spatial structure of non-agricultural employment complexes. High percentage of non-agricultural occupations among the rural population is due to the impact of both cities as employment centres and industrial clusters located beyond city boundaries.

Non-agricultural structure of employment, typical for many suburban villages undergoing urbanization, is not the only measure of their transformation.

It has been proved that the occupational structure is unstable even in regard to particular branches of the national economy. (M. Charkiewicz 1965, p. 104). In connection with the intensive modernization of production processes and the introduction of new technologies the demand for highly qualified labour in specialized fields is constantly growing. This situation exerts a certain influence on the differentiation of industrial employees division of labour and as a consequence, on the progress of "occupational" urbanization of a large rural areas.

A characteristic feature of this process is a widening range of professions, depending: on the type of plant, type of production, degree of mechanization and a few other factors. In connection with this in non-agricultural employment complexes the types of specialization most likely to occur are those reflecting the production structure of the main centre. Apart from that other occupational groups, connected with local as well as more distant production centres are represented. Therefore, it is important to consider the problems of occupation structure, on some detail, which allows to grasp the impact of individual plants and to reconstruct the mechanizm governing the "occupational" urbanization of rural population.

During field work and statistical analysis a number of interdependencies between the type, size and influence exerted by given centres, the number of commuters and socio-occupational changes in the structure of rural population have been determined. Settlements which have undergone the most pronounced transformation belong to the Bielsko-Biała, Rybnik-Boguszowice and Chrzanów-Trzebinia employment complexes; in other words they are situated in the vicinity of old industrial centres. New centres, built since World War II during the socialist industrialization, have not changed the socio-occupational structure of rural population in spite of the strong influence they already exert on their hinterlands. Apart from that the above mentioned centres have considerably augmented the non-agricultural economic activity of rural population. This in turn caused further socio-economic urbanization of the rural areas of the Silesian and Cracow regions.

4. DELIMINATION OF URBANIZED ZONES

A basis for the delimitation of spatial influence of urbanized zones, regarded as elements of urban-industrial agglomerations, were density and employment structure indicators. Referring to O. Boustedt's urban region concept, with the specific spatial structure of Upper-Silesian agglomerations in mind, the following values of delimitative criteria were used: (J. Rajman 1969, p. 60).

a) urban areas above 500 people per 1 km^2 and over 90% outside agriculture;

b) suburban areas above 200 people per 1 km^2 and over 70% outside agriculture;

c) complementary zone — above 150 people per 1 km^2 and over 50% outside agriculture;

d) transitional zone — above 100 people per 1 km^2 and over 40% outside agriculture.

With the density lower than the national average the only communes to be considered were the ones where the urbanization index percentage of economically active residents exceeded 50. The additional criterion was the territorial contiguity of administrative units.

On the basis of the above mentioned criteria, urbanized zones constituting parts of larger urban regions have been delimited. Due to considerable compactness of administrative units the above mentioned zones include 83.5% of

the Region's population and 60.5% of its territory; this is 2,279,200 people and 9234 km². The average density in the previously mentioned urbanized zones is 247 per km², which is high, since most of the zones include arable land and woodlands.

Out of the 29 urbanized zones, which have been delimited on the basis of the previously mentioned criteria only 21 developed full range. In 6 of the fully urbanized zones core regions have not yet been formed, although main centres of those zones possess an urban functional structure. They are characterized by a higher than average employment in agriculture (Lubliniec, Pszczyna, Strzelce Opolskie, Żywiec) or by low density due to the inclusion of arable lands and woodlands (Lubliniec, Strzelce Opolskie) into administrative urban units.

The population of urbanized zones ranges from 24,600 (Zawadzkie) to 244,400 (Częstochowa); ten times more. The size of the zones is not so differentiated: 130 km² in Cieszyn zone and 610 km² in the Bielsko-Biała urbanized zone.

A characteristic feature of the urbanized areas within the marginal zone of the Upper Silesian Industrial District, is a considerable difference in the degree of their "formal" urbanization (in administrative terms), which ranges from 27.2% of urban population in the small centre of Skoczów to 77.5% in the Mikołów–Tychy mining zone.

Economic urbanization indices do not show such considerable differentiation (58.5% in the Żywiec zone and 87.5% in the Tarnowskie Góry zone). A comparison of those indices affirms the previously formulated hypothesis on relatively retarded process of the "formal" urbanization of the Upper-Silesian Industrial District, in regard to economic changes (J. Rajman 1969, p. 49).

An analysis of the internal structure of urbanized zones proves that the overlapping of regions characterized by large concentrations of non-agricultural population is a typical phenomenon. Boundaries of urbanized regions seem to possess different features in relation to administrative boundaries and those of particular economic districts. The present zonal pattern being the spatial reflection of influence exerted by urban industrial centres (considerable zone to zone commutation) and transport systems, points to the non-uniform development of urban-industrial agglomeration patterns, still vast agricultural and transitional areas within the marginal zone of the Upper-Silesian Industrial District remain beyond the zones delimited. The analysis demonstrated that the intensity and pace of urbanization processes depends on the phase of economic development of each particular segment of the Upper-Silesian agglomeration. Its typical features are large spatial contrasts of settlement structures, bigger than in other industrial regions of Poland. They are due to the uneven economic and demographic growth of particular centres determined by the historical partitions of Poland and unequal pace of industrialization during the capitalist period. The postwar industrial growth substantially diminished those disproportions. The present trend is to follow the principles of planned economy in such a way as to assure a rational production profile in particular subzones of the Upper-Silesian Industrial District. It may be assumed, by analogy to overall country scale, that functionally related urban regions will appear around present subregional industrial centres (Bielsko-Biała, Częstochowa, Rybnik) of the Upper-Silesian agglomeration. Due to integration processes there has appeared a new form of complex spatial settlement pattern in areas functionally connected with the Upper-Silesian Industrial Region. According to the classification proposed by S. Leszczycki *et al.* (1971a, p. 70) it is typical for the initial stage of metropolization of urban settlement. The non-agricultural

employment complexes and urbanized zones defined in this study are regions where the processes leading to metropolization appear most evident.

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ELABORATING OF ALTERNATIVE PLANS FOR THE DEVELOPMENT OF A SETTLEMENT SYSTEM

W. E. Bruno Tauche

1. The below considerations refer to the work of a research team within the Geography Section of the Martin-Luther University entrusted with drafting alternative plans for the development of the settlement system in the area of Halle–Merseburg. The research has been scheduled for a 3-year period, and the below report accounts for the progress made during the past two years. Ten geographers representing various fields of specialization are taking part in the project.

The principal target of our research encompasses presenting a possibly large number of alternative plan versions for the development of the settlement system within the Halle–Merseburg area. Such drafts are to be used as a basis for territorial planning within the area under research. They permit certain general views concerning methods to be applied. It is just this scope of problems that I wish to cope with, in order to explain the way in which we attempt to use the analysis as a starting point to form a prognosis. The versions to be worked out shall thus supply the basic data for the planning discussions with proper authorities and at the local level. The motions to be formed and put forward, must give consideration to the present situation within the area, including its historic background. This in turn must be compared with the social requirements and premises in order to draw necessary conclusions. Such a trend brings the matter close to the problems involved in the Operation Research. It is for this reason that considerations involving a cybernetic way of reasoning form the starting point for the research.

With due consideration given to the complexity carried by the term settlement system, the above task would appear too large to be handled by a small team. We are therefore forced to accept a logical starting point for our research, in order to come up with an operational method and necessary professional limitations.

2. A question arises as to what a settlement system actually means. We shall emphasize at this point that a settlement system reflects to a high degree the human activities within the area in question on the whole. We must therefore keep in mind that a settlement system is influenced by factors originating from all the domains of the social life, be it of an economic, cultural or of political nature. As far as the steady improvement of the production methods is concerned the settlement system has developed into an essential category determining the shape of the territory in question. The historical development process, and the impact of the socialist social order find their expression in the structure, functions and individual components of the system as well.

The designation "settlement system" must have been adopted, as the individual settlements do not exist in isolation from one another, but each of them forms an integral component part of a certain entity.

We shall therefore consider a settlement system as a limited number of nodes K (settlements or communes), and denote the functions thereof as F, and the relations thereof as R. The arrangement in space is reflected by the network of settlements. Nodes that do not fall within the system situated outside the selected territory as well as the remaining territory outside the area occupied by the settlements, form the relevant environment of the system.

It must be stressed that settlements considered as a set of places of residence, of work and the recreation of an individual and of the society, must ensure a socialist way of life. Such basic functions may be realized only when contributed to by a substantial number of population involved, i.e., within a settlement system.

Below, you will find some more comments concerning the three fundamental values of the system:

1. The set of nodes forms the starting point for the research. It must be considered of a prime importance also from the historical angle.

2. Each of the nodes corresponds to a single elementary system.

3. The unity of a node as determined consists in K being bound as a whole to solve a specific task which corresponds to the function of the K and finds its justification in the function of the system.

4. The implementation of the function of K stipulates the course of processes within the K that require interrelations with other nodes or with the environment thereof.

This is reflected in a set of relations. The latter corresponds to the pattern of relations and designates the structure of the system.

The relations furnish the cause of movements, i.e., interactions, flow of materials, energy and information. One can analyse the relations from the angle of a node, providing that the functions of the latter are known, or, on the other hand, from the angle of movements. Relations are functional references, since every relation is determined by specific functions.

The set of functions ensures the totality of a system. The functions are of an immaterial nature. The knowledge of this fact is indispensable, since any planning and prognosing, as well as all administrative measures, are commenced with the determination of targets, i.e., with the transfer of functions for the object involved.

One must also be aware of the tasks of the settlements, since a comparison with the targets determined allows for necessary alterations. The functions can be derived both from the source responsible for the functions within a node, and from the interactions.

3. If we were to compare, the settlement systems within agricultural areas with those within the agglomeration areas, it would become clear that there are no differences. Both are equal according to the fundamental principle. They differ only as to the type and nature of their objectivity. Density causes a higher dependence of nodes from one another, and a higher specialization concerning the determination of tasks for each of the nodes separately. Industrial communes, frequently grouped around a single plant, are noted to exist side by side with residential and other communes.

An examination of a settlement system in relation to a spatial order based on socialist principles is to be conducted. This involves nature protection as an integral component of eminent importance. Agglomerations are known to create problems of danger to health. In agricultural areas, on the other hand, the pri-

me consideration involves maintaining a balance between the demands of the farming and preservation of the landscape.

4. We have thus laid down our working plan in accordance with the preliminary considerations adopted as the starting point (Fig. 1). The heterogeneous data has been selected as to obtain three values: set 1 — description of the nodes, est 2 — description of the environment of a system in question with particular attention paid to the land use within the system under research, set

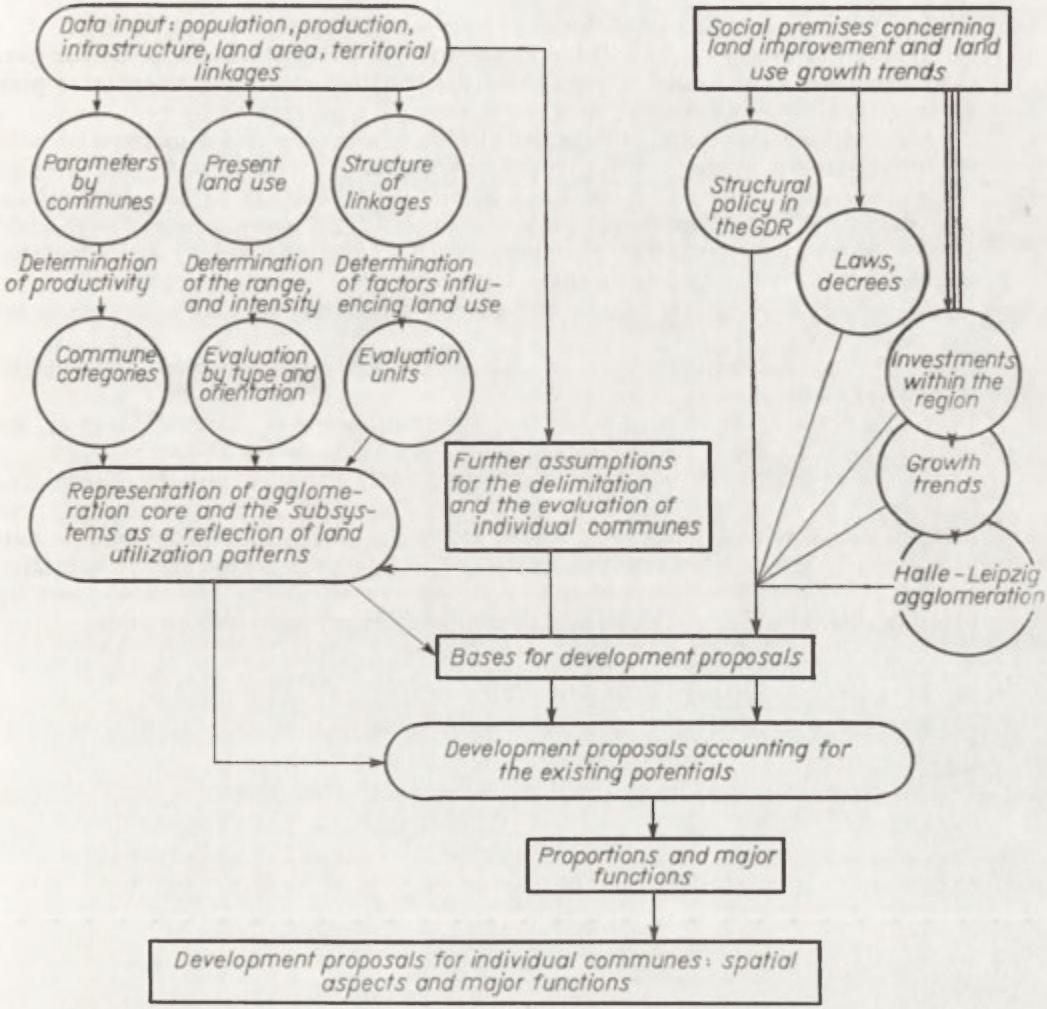

Fig. 1. Research Programme of the Study Group: "Settlement System"

3 — description of the structure of the system, the territorial interrelations. Further partial results will be obtained from separate data, and the distribution of the latter in space.

It should be stressed at this point that the above procedure would yield a multitude of possibilities of combination and of data comparison that cannot be utilized to the full extent. This concerns, such partial results that reach be-

yond the set 3, e.g., the limitations of the planning area, the mathematical correlation between the various data, e.g., between the employment within the tertiary sector and the population, or the type of the territorial and statistical distribution of specific initial data (like the employment, age groups, age of buildings, intensity of traffic etc.).

The main part of the diagnostic evaluation that follows is obtained by describing the 3 sets from the point of view of:

(a) account of the present land development and of the territorial interactions, and

(b) evaluation of facts for the development of the settlement system.

Evaluation in aspect (b) will help to single out the problems specific for particular areas. Those would in turn yield the starting points for alternative plan elaborations.

Assumptions concerning the social questions are considered in parallel with the analytical procedure. They represent demands, limitations and trends. A comparison of those at hand with assumptions relating to social questions, particularly a confrontation of problems specific for given areas would yield directives for the alternative plan versions. The versions proper are presented in accordance with two principles:

(a) the area principle, i.e., in compliance with the location and area coordination;

(b) the specialization principle, i.e., coded in compliance with the specific territorial elements.

While dividing the future functions, a particular stress should be laid on the effects upon the three fundamental principles as mentioned above.

To summarize it should be stressed that while working out the alternative plan versions of prognoses, the operational plan would be divided into the two main sections, whereas section 2 would assume a course counteropposed to that of section 1. We proceed from the detail to the general aspect and formulation of the problems involved, which is followed by summary directives, and by bringing diagnoses and conclusions possibly far apart from one another.

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ON THE DEVELOPMENT OF THE INDUSTRIAL STRUCTURE OF LARGE CITIES

JOACHIM HEINZMANN

The shaping of the developed socialist society under conditions of the scientific and technological progress involves qualitative changes within the territorial structure of the national economy. Industrial agglomeration areas (*industrielle Ballungsgebiete*), particularly the large cities in these areas, prove to be dynamic elements in this respect, due to the trend towards the territorial concentration of production, scientific potential and population. Such areas already represent the most effective territorial structural types in all of the GDR (H. Lüdemann, 1969), and they have important natural and economic growth reserves.

The cities, particularly the large ones, offer the best possibilities of ensuring their inhabitants all the essential prerequisites for their personal development — which is after all one of the main targets of socialism. The cities offer a wide spectrum of specialized jobs, and furthermore of the possibilities of educational and cultural activities, as well as social and health facilities, living, service and traffic conditions. Modern public transportation permits a high degree of spatial mobility.

The practical implementation of such potentials will help to promote the attractiveness of the large cities and thus the process of urbanization.

The above confronts the geographical research with the task to find the solutions to problems of the optimum structure of industrial agglomeration areas, and particularly of the large cities in these areas. An optimal structure of the national economy including its territorial units is becoming a direct factor of growth at the present stage of productive forces development in the GDR.

Optimization of the structure of industrial agglomeration areas including the large cities is equal to the future oriented proportional development of all the spatially linked elements in the process of reproduction. The qualitative and quantitative spatial proportioning of the structures of production, resources and the infrastructure within the territorial units have become an important prerequisite of effectiveness for the social and economic development.

Its is in particular the elements of the production and science structure that will produce before long new impulses for the spatial and structural development of industrial agglomeration areas and the large cities in these areas. The increasing automation of production, the shifting over to the great scale and mass production, and the growth of cooperation add to the trend towards the concentration of production in larger plants and also on the regional scale.

Assuming that the agglomeration presents the function of an industrial development (G. Mohs, 1964) it would follow logically that a differentiated pro-

duction structure yields differentiated development impulses for agglomerations of different structure. Specific industrial branches are stimulating (each one for itself as well as in combinations) to a particular degree the large city development. Such branches include electronics and electrical engineering, the production of devises for EDP and information processing, the production of scientific instrument and of machine tools. They are particularly stimulating the rate of development of the national economy under the conditions of the scientific and technological explosion. It is especially the agglomeration cores (large cities) that offer locational advantages to such industries. The advantages of large cities for the industrial development are as follows (J. Reiner, 1968):

— manifold possibilites of production linkages within a given territory;
— close contact to the capacities of scientific research development;
— a purposeful usage of the large and qualified labour potential;
— an affective usage of the developed technical infrastructure.

It must be taken into account, in order to obtain an effective production structure of a territorial economic unit that such economic areas do not represent any independent economic organization. The reproduction process of any area would never manifest a closure equal to the national economy on the whole. Every economic area has got specific production-and-economic functions within the social reproduction process. The proportionality as related to the whole of national economy involves the proportionality of the territorial units.

The practical planning task for the development of production structure of any economic area consists thus "... in the determination of the most effective territorial distribution of industry and in the establishing of the most effective territorial proportions of production" (A. N. Yefimov, 1967).

FORMATION OF THE MANUFACTURING STRUCTURE OF PRODUCTION IN LARGE CITIES

Making the effective use, from the angle of production, of the recent scientific and technological achievements involves, i.a., the implementation of new technological methods, the application of new production materials, the manufacture of new products. This aims towards changes in the branch structure of production, both within the national economy on the whole, and within the

TABLE 1. The share of industrial branches in the gross industrial production (in %)

	GDR		District of Leipzig		Urban region of Leipzig	
	1960	1967	1960	1967	1960	1967
Primary industries	28.2	28.7	33.6	27.2	14.7	13.6
Metal working industries	34.6	38.0	31.7	39.2	45.7	52.2
Light industry	21.0	20.5	23.0	22.4	28.5	25.5
Food processing industry	16.2	12.8	11.7	11.2	11.1	8.7

territorial economic units. Differentiated rates of growth lead above all towards changing proportions between individual production branches or groups of production in the production volume of the national economy or to changing proportions of a territorial economic unit.

Distinct shifts in the proportions between the industrial branches witnessed during the recent years are the effect of the scientific and technological devel-

opment factors and of new consumption demand pattern of the society. This world-wide process in the highly developed industrial countries (G. Schulz, 1966) is manifested particularly by the growing share of metal industries, while the basic, light, and the foodstuffs industry show a proportional decline. This trend can be seen also in the GDR.

Table 1 shows that the branch structure of the industry in large cities differs essentially from the national average. The outstanding position of the metal working industries that accounted, e.g., in 1967 in Leipzig for already 52% of the industrial gross production is in this respect remarkable. This trend towards the increasing importance of the metal working industries within the large cities is expected to continue in the future. This is explained by the fact that on one hand this sector of industry includes highly dynamic branches (electronics, scientific instruments, EDP equipment) and on the other hand this is the result of its specific locational requirements (demand for cooperation within research and development centres, for highly skilled labour, relatively limited demand as concerns land, water supply, etc.). This explains why the metal working industry finds advantageous production conditions in the large cities.

SPATIAL ORGANIZATION OF PRODUCTION WITHIN LARGE CITIES

"The social labour division grows due to the increasing differentiation of production elements and production processes" (G. Mohs, 1967) which also includes the territorial labour division. The process of territorial labour division is expressed by the territorial aspects of concentration, linkage, specialization and the cooperation of production in the rational economy management, and in the intensification of relations between production and science.

The concentration of production generally advances in two directions. The "branch-and-plant" concentration finds its reflection in the size of production plants. The spatial concentration brings about the accumulation of production capacities within limited areas or sites.

It should be stressed that important spatial aspects are also characteristic of the so-called branch-and-plant concentration. Thus, the general trend towards

TABLE 2. Industrial plants, employment and industrial gross production in the urban region of Leipzig (1965), by plant size categories

Size of plants (employees)	Plants	Employees	Industrial gross production	Industrial gross production (employee)	
				Leipzig	GDR
	%	%	%	1000 M	1000 M
0– 25	46.6	3.8	3.9	30.5	25.2
26– 100	39.6	12.5	11.9	28.5	28.7
101– 500	12.5	17.0	17.2	30.4	34.5
501–1000	3.4	15.8	16.7	32.0	31.8
> 1000	3.9	50.9	50.3	29.8	33.0
	100.0	100.0	100.0		

the increasing plant size, being dependent on the time period and the branch involved, leads to changing locational requirements which must be taken into consideration at the location decision.

A special set of problems is brought about in the large cities of the GDR by the high degree of the dispersion of plants and industrial land as a result of

historical development. The share of small and medium-size plants in large cities is higher than the average for the GDR. In Leipzig for example 79% of all plants had less than 100 employees in 1967 (Table 2).

The hypothesis that the labour productivity in industry increases with the growth of plant size can be regarded as proved. L.Berry and J. Schilin (1965) demonstrate this on the basis of the abundant data records (Tables 3 and 4).

TABLE 3. Labour productivity by plant size categories in the industry of the Soviet Union (1960)

Plant size categories according to gross output (in 1000 rubel)	Percentage in the total number of industrial plants	Production per employee (size group 1 = 100)
up to 100	12.0	100
101– 500	26.2	159.2
501– 3000	43.8	247.8
3001–10,000	12.5	318.1
10,001–50,000	4.7	426.3
over 50,000	0.8	526.4

TABLE 4. Gross social product per employee in the American industry

Industrial plant size categories (number of employees)	Gross social product per employee (in $ 1000's)			
	1947	1954	1958	1958 in % of 1947 returns
1– 19	4.80	6.03	7.66	160
20– 99	4.97	6.37	7.82	157
100– 499	5.35	7.25	8.71	163
500– 999	5.42	7.87	9.56	176
1000–2499	5.41	8.50	10.46	193
> 2500	5.05	8.43	10.91	216

Thus, a high share of small plants equals to a certain degree a non-rational usage of the social labour potential. This is why the problems of the rationalization and automation of small and medium-size plants within large cities deserve special attention, the more so, as the labour demand by the tertiary sector is particularly large in such areas.

It is due to small size and the lack of special locational requirements that the small and medium-size plants extremely vary in the choice of their location. Their sites within the large cities are therefore highly dispersed all over the city area. As concerns the re-shaping of entire city districts there is a necessity of elaborating alternative plans for the small plant site location policies. Two ways seem to be of a particular advantage:

— concentration of small and medium-size plants within special industrial parks (*Industriekomplexe*),

— linking the small and medium-size plants to the production programmes of dominant industrial plants, particularly under the schemes of the spatial rationalization projects.

The problems of spatial concentration are not limited to small and medium-size plants. A considerable portion of large plants in the cities have their production and storage facilities situated in various sites. Such a site dispersion (see W. Menge, 1965; J. Heinzmann, 1971) is particularly typical of the industrial and mixed districts of large cities that were developed during the capitalist period at the end of the past century. The excessive building density on the plant area has limited the possibilities of expansion on the plant site. To secure more space the plants were purchasing any lot even at the cost of the further site dispersion. A large plant in Leipzig occupied in 1968 an area of 20.5 ha; out of this area 15.8 ha were claimed by its five components (of a minimum of 0.7 ha and a maximum of 7.2 ha area each). Further 4.7 ha were dispersed into 29 pieces (ranging from 16 to 13.850 sq.m) and were used for storage. Spatial concentration of production within the large cities of the GDR presents a task to be carried out continously in the future.

DISTRIBUTION OF INDUSTRIAL SITES WITHIN LARGE CITIES

An effective territorial structure of the national economy, particularly that of the large agglomeration areas and their cores, is relevant not only as an important factor for increasing the GNP, but also as one to meeting the requirements of every individual of the socialist society. "The growing importance of free time for the production functions of the society, for the reproduction, and for the development of personality within the communist society, justifies speaking of an unusual increase of importance of all the characteristic urban features that present the spatial arrangement in terms of time" (S. Shvarikov, 1968).

It becomes clear that a large city with a predominant concentric pattern could hardly answer to the above requirements to full extent. The concentricity reflects the historical process of emergence and development in the course of which ring by ring were spreading around the centre, while most attractive were the grounds along the main traffic routes. Such a pattern proves not flexible enough for the functional development of a city. Such a development found its expression in the assignement of the different functions of a large city to various zones.

The demand for a spatial separation of the place of work and the place of residence is in its absolute form no longer justified. The principle of the spatial separation of functions has been formulated in the Charta of Athens as a postulate of a lasting effect. It presented an attempt at stopping the ever more visible chaos in urban growth of the first decades of the present century, and an approach to look at the city as a structural whole. The Charta laid stress on the functions of living, working, recreation, and traffic.

The present stage of development of productive forces renders the demand for the spatial separation of these functions outdated. It is not the schematic side-by-side in the spatial arrangement of functions that can be regarded as the main principle, but the rational, optimal intertwining of functions that may supply an answer to the problem. What a schematic separation of functions may run at is shown by the examples of dormitory towns, employment centres or large shopping centres, all of them unable to meet the demand of man in a complex way and of attaining a higher economic effectiveness.

It is in line with the socialist approach to the shaping of an urban way of life to make use of all the possibilities of combining the functions of working, living, servicing and recreation. "An increasing concentration, cooperation and combination of man's social activities leads in urban development to the spatial

concentration, the condensation and overlapping of functions" (U. Lammert, 1970).

A spatial intertwinning and the overlapping of functions will become a decisive element in shaping the spatial structure of a city.

When considering the trend toward the spatial concentration of functions as presented above it will become clear that the principle of zoning the functions can hardly provide the only basis for long-term city planning. According to E. Schulz-Fielitz (1966) as the target may be considered "... the development and establishing of spatial city-development systems with a high adaptation ability, with potential changeability. Such systems must enable the growth, regression and displacement of types of uses". It is necessary for the socialist urban research to develop a model system accepting the integration of city within a large-scale regional scheme. This model has to show the flexibility of the spatial functional patterns and of dynamic functions.

Concentric models fall short of ensuring such a flexibility to a sufficient degree, particularly with view to their regional effect. They include a reduction of intensity and thus of quality of urban life from the centre toward the outskirts of the city.

It would be rather axial or network structures that would better match the dynamic of urban functions. The concepts presented by R. Hillebrecht (1966) meet those requirements to a large degree. His suggestion is to assign new functions to places of secondary or tertiary importance within the urban region. Such places "... assume partial functions for the entire region which will be transformed into a new town of regional character with axial or network structures".

The growing mobility of population, as well as the already visible effects of technological progress in the public transportation system, help to promote the above development and at the same time enable to cover longer distances within a shorter time.

The above general trends of the spatial and functional patterns of large cities have been referred to so far only, inasmuch they could provide a starting point for qualitatively new criteria of evaluation of industrial location. The locational selection by industry is bound to join this general development trend or to participate in its formation.

The principle of spatial separation of functions of places of work and of residence, as mentioned above, provided a decisive rule for the location of production plants within the city. It is self-explanatory that obnoxious plants must be located as to reduce their harmful effects upon the environment to the minimum. New scientific and technological achievements offer a possibility of a general reduction of pollution and damages to the environment. A small distance between the places of work and the places of residence should be a target of industrial location.

The analysis of locational trends in industry within large cities on the international scale points towards advantages offered by the peripheral zone. Variations, however, can be noted in respect to individual industrial branches and in respect to the distance from the city centre. The factors of such a shift towards periphery are the following:

— Many industrial plants are no longer able to expand within the central urban area due to high building density at the centre; thus the increasing demand for industrial land cannot be met.

— The general reconstruction policies within the city bring up the question of industrial relocations which are aimed to reduce the degree of pollution and other environmental disfunctions for the benefit of city inhabitants.

— Industrial plants prefer to have neighbouring land reserved for new requirements of scientific and technological progress.

— The peripheral zones offer reserves of vacant land that ensure advantageous conditions particularly for the development of large industrial parks.

— In the capitalist countries the above considerations are furthermore influenced by land price speculations.

In the case of the industrial plants with heavy demand for land within primary metals and machinery branches in particular, advantageous conditions are offered on the outskirts of large cities.

While following the above growth trend towards the peripheries the plants are making use of the advantages offered by the peripheral zones with view to an extensive demand for area, and also they benefit from the advantages of the large city.

Variations in the peripheral movement according to the distance from the city centre reflect certain considerable differences between the cities of the capitalist and the socialist socio-economic systems. The problem of time claimed by covering the distances is of particular importance. In the case of capitalist cities the distance is referred to individual means of transportation. O. Boustedt (1961) refers to the research by Isenberg while estimating the new development areas for Munich within the distance of up to one hour travel time by car from the centre of the city. For the large socialist cities it is the range of reach of the public local transportation that makes a decisive location selection factor.

The presentation of the trend toward peripheral development should not imply that industry might be excluded from the inner city districts. On the contrary such a tendency must be brought into harmony with an intense usage of the industrial land within the city.

Apart from the phenomena of the move towards peripheries, certain other trends can be identified as concerns industrial site selection. It has already been mentioned that with the relative reduction of the number of industrial employment more persons find employment near the areas of population concentration. This applies with only a few exceptions to all the infrastructural elements.

Otherwise, a certain structural change is noted within the industry itself. This finds its expression in a relative and sometimes also the absolute growth of employment in research and development, planning and management, and data processing. This involves the trend towards the location of these industrial jobs in the inner city districts, in order to ensure a more efficient exchange of information to take full use of the existing facilities. The up-to-date communication systems offer enough possibilities to control the production locations situated within the peripheral zone, from the management centres in the inner city. In the recent years in the planning of Soviet large cites special attention has been paid to the designing of office and management centres.

The recent developments in science and technology allow to expect (and the first practical examples prove this trend) that some branches of industry, due to changes in their locational requirements, are directly capable of being located within the inner city in the immediate neighbourhood of housing districts. This applies, i.a., to electronics and electrical engineering with its tendency towards the product compactness, to scientific instruments, printing and publishing, etc. It can be said in general that as pollutions and other adverse effects upon the natural environment diminish, and the possibility of production accomodation in multi-storeyed buildings increases, the trend towards locationing industry within the inner city districts may grow. "The quantitative and qualitative changes within the structure of the economy, and thus in the employ-

ment pattern, lead (as concerns the city planning and its growth) towards a concentration of employment within the city centre, the traditional place of service location" (Hillebrecht, 1962).

N. Baranov points in one of his latest works to the fact that nearly 30% of industrial plants represent such a pattern of their production methods, materials handling, and the interaction with the natural environment that they can be located within the direct neighbourhood of housing districts.

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CHANGES IN LAND DEVELOPMENT WITHIN THE PERIPHERAL ZONE. CASE STUDY OF THE HALLE–LEIPZIG AGGLOMERATION

HANS RICHTER

The land development pattern is the result of the natural conditions of an area in question re-modelled by its present and past use. This pattern, formed by natural, social and technical factors is a spatial expression of the dialectic interrelationships between nature and society. It heavily influences living and working conditions of the population and the present as well as future state of natural resources, needed for production and reproduction (soil, water, air, land, minerals, biological and other processes).

The state of land development is thus the expression and the measure of territorial effectivity which should not be evaluated singularly, but on the complex basis.

The land utilization and the natural conditions when brought together yield numerous types of land development areas, like lowlands dominated by agriculture and water management; the Pleistocene low plains and highland dominated by agriculture and forestry as well as mining districts, medium-size and large cities with their peripheral zones.

A general survey of all the essential types of land development areas in this country is not so far available. Such survey would be of a high value for planning, since areas of an equal state of land development require also equal development measures to be taken for their conservation and transformation in order to ensure the highest territorial effectivity.

The peripheral zone of a large city presents a specific and most complicated type of land development area. It surrounds and is contiguous to the built-up areas. Its exceptional position in relation to the more distant environment is secured due to the close, multi-functional links with the city centre. If to consider the city centre oriented linkages in particular, one can distinguish between the outer and the inner peripheral zone, on the basis of the range of the important functions performed.

The outer peripheral zone is limited by the outskirts of the settlements with commuter traffic gravitating still towards the city centre (see also Brause, 1964). It encloses the inner zone that comprises the areas contiguous to the city and utilized for city serving functions although not located within the city built-up area. If 40 to 50 per cent of the total area is claimed by the city-serving functions an inner peripheral zone usually develops. Such areas are seldom territorially continuous and the fact that they are dispersed changes substantially the land use pattern of an initially agricultural or forest area. This value can be used as a basis for delimiting the external boundary of an inner peripheral

zone. The share of city-serving uses increases within the zone to 70 per cent and more.

Still larger areas situated within the outer peripheral zone and even beyond it are also occupied by city-serving functions. However, the percentage of such lands which form water preservation, recreation and mining areas is lower than the percentage of agricultural and forest land. The state of land development is therefore determined by those latter.

The land development in the outer, and in particularly the inner peripheral zone, is still more complicated due to the fact that the land utilization within the city peripheral zone is, apart from the city-serving and local needs, to be used for such regional and supraregional functions as major airports, mining areas (like brown coal mines), industrial districts (Brause, 1964). Land use problems of an inner peripheral zone, disregarding other than its local functions, are presented below.

THE PRINCIPLES OF LAND DEVELOPMENT STATUS OF THE PERIPHERAL ZONE

The vicinities of every urban centre accomodate a certain number of land-consuming functions or uses, such as housing estates, industrial facilities, transportation in a broad sense, municipal, local recreation, and national defence facilities. The above groups of facilities are arranged in Table 1 showing functional elements identified in a field survey within the inner peripheral zones of Leipzig, Halle and Halle–Neustadt (Richter, 1964, Scholz, 1964, Billwitz and Janckel, 1971, city plans of Leipzig and Halle). Such a classification presents a broad scope of functional elements within the inner peripheral zone, although some uses, like industrial-storage areas, or mining areas, should have been classified in a more detailed way. Table 1 shows that the inner peripheral zone, along with the urban built-up areas and the large-scale strip mining and reclamation districts rank among area types showing the highest variation of land use elements.

Such elements strongly differ from the point of view of their area demand and arrangement in space. There is a substantial number of elements dispersed all over the entire zone, and an equally large number of elements represented either sporadically or singularly. This results in a great spatial variability of functions and of spatial patterns, the variability which is a specific feature of land utilization in the inner peripheral zone. It also determines the state of land developed both as concerns individual elements of land use and parts of the structural parts of the peripheral zone. The direct association between settlements, places of employment, public transportation facilities and local recreation areas brings major advantages, as those facilities are made available to both inhabitants of the peripheral zone and the city residents.

There are also certain service disadvantages of the above pattern. They result from the direct neighbourhood of such "sensitive" uses as housing and residential areas, and obnoxious uses, which are not only endangering man's comfort and health locally, but also have an adverse effect upon the neighbouring areas situated in various distance. These disfunctions include noise, smell, dust, etc. Closely confined space and far-reaching functional variability result in further general disfunctions associated with every change of land use like the development of extraction of valuable minerals, the extension of transport network, in recreational, housing or industrial areas. In many instances, the change or conversion of land use provided that it is not intended to be effected

TABLE 1. Land use categories in the inner peripheral zone

			No.	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*K*
Transportation area		Railway	01	4	4	2	1	3	4	1	2	3	4
		Tramway	02	4	4	1	1	3	4	1	1	3	2
		Highway	03	4	1	3	1	4	3	1	4	3	4
		Beltways	04	4	4	4	1	3	3	1	1	3	4
		Thoroughfares	05	4	3	2	1	3	2	1	2	3	2
		Marshalling yard	06	3	2	3	1	4	4	1	2	3	4
		Channel	07	4	1	2	1	4	1	2	1	3	2
		Canal harbour	08	3	1	2	1	4	4	1	1	2	4
		Airport	09	3	1	3	1	2/4	4	1	4	2	2
		Approach	10	3	1	(4)	1	1	4	1	4	—	—
	Surface	Transmission line junctions	11	2	1	(3)	1	1	1	1	4	3	3
Lines		Water pipelines	12	4	3	(3)	1	1	1	1	1	2	3
		Heating pipelines	13	4	2	(4)	1	1	1	1	1	2	3
	Underground	Gas pipelines	14	4	3	(3)	1	1	2	1	1	2	3
		Oil pipelines	15	4	2	(3)	1	1	2	1	1	2	3
Utilization of natural resources	Extraction of building materials	Mines	16	2/3	4	3	3	4	3	1	3	1	2
		Dumps	17	2	4	2	1	4	3	1	3	1	2
		Dump slopes	18	2/3	4	3	1	4	2	1	2	1	1
	Water supply & water protection	Water works	19	2/3	4	3	2/3	4	1	1	2	3	4
		High water protection facilities	20	4	2	2	3	—	1	2	1	3	—
		Water protection area	21	3	2	3	3	1	1	3	2	3	3
Solid waste dump grounds	Dump		22	2	4	4	2	4	3	2	1	1	2
	Dump slopes		23	2/3	4	3	2	4	1	1	2	1	1
	Accidental		24	1	3	1	1	2	3	1	4	3	1
Liquid wastes	Sewage plant		25	3	2	3	2	4	3	2	1	3	4
	Cemetery		26	2/3	4	2	2	3/4	1	1	1	3	3
Local recreation grounds	Parks, historical & cultural monuments		27	1–3	4	2	1	1	1	2	1	2	3
	Zoological garden		28	3	1	3	1	4	2	2	1	3	4
	Stadium, swimming pool (under roof)		29	2/3	4	3	1	4	2	1	1	3	4

		No.	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*K*
	Small scale sport grounds	30	1	4	3	1	1	1	1	1	3	3
	Open air swimming pool	31	2	2	2	1	4	1	2	1	3	2
	Allotment gardens	32	2/3	3	3	1	2	1	2	1	3	1
	Suburban woods	33	2/3	2	2/1	3	1	1	2	2	1	1
	Nature preservation area	34	1	2	2	3	1	1	3	2	—	1
	Landscape preservation area	35	3	4	3	2	1	1	2	2	1	1
Military grounds	Barracks	36	3	2	2	1	4	2	1	4	1	4
	Training grounds	37	3	2	3	1	2	2	1	4	1	1
	Hospital, sanatorium	38	3	2	3	2	4	1	3	1	2	4
Settlement areas	Rural settlement	39	2	3	3	2	3	1	3	3	2	2
	Residential commune	40	3	3	3	1	4	1	3	2	2	4
	Small town	41	3	4	3	1	4	2	3	2	3	4
	Dispersed	42	3	3	4	1	4	1	3	1	3	4
	Compact urban housing	43	3	3	4	1	4	2	3	1	3	4
Industrial areas	Industrial areas	44	3	3	4	1	4	3/4	2	1	2	4
	Storage areas	45	1–3	3	4	1	2/3	2	1	1	1	1
Agricultural areas	Arable land	46	3	3	1	3	1	1	2	3	3	1
	Arable land, intensive use	47	3	3	3	3	1/4	1	2	1	3	3
	Irrigated fields	48	3	1	1	3	1/2	2	2	4	3	1
	Irrigated pastures	49	3	3	1	3	1	1	2	3	3	1
	Gardens, orchards	50	1/2	3	4	2	1/2	1	2	1	2	1

Appendix to Table 1
Explanation of code figures

		1	2	3	4
A	Area size	small (< 2 ha)	considerable (2–10 ha)	large (> 10 ha)	linear
B	Type of area	mono (1/2×)	singular (4/6×)	dispersed	strongly dispersed
C	Trend of area size change	declining	constant	growing	strongly growing
D	Dependence on the natural conditions	none	partial	complete	—
E	Changes in natural conditions	negligible	far reaching	on the whole	
				reversible	irreversible
F	Degree of obnoxiousness	none	temporary	constant	constantly intense

		1	2	3	4
G	Susceptibility to natural and technological disfunctional influences from the surroundings	none/negligible	differentiated	high on the whole	—
H	Dependence of functions in proximity of a city	imperative	historically imperative	and conditional	conditional
I	Change of function with the existing technological facilities retained	possible	conditionally possible	impossible	—
K	Possibility of technological conversion	complete		conditional	
		low expenditure involved	high expenditure involved	low expenditure involved	high expenditure involved

dispersed — analogical with space proportions of a rural settlement network (average distance = 2 km)

at the cost of the arable land, involves substantial expenditure in order to transform or to dispose of the remnants of the earlier form of utilization. Such a land use change is sometimes out of the question. The existing structure of land use in large portions of a peripheral zone brings about the same difficulties of land use conversion which confront the city itself. Table 1 demonstrates the differentiation of evaluating the disadvantages according to the individual land use elements.

The above problems of the peripheral zone are still more aggravated due to its earlier mentioned functions of regional or even supraregional range and also due to external factors. The numerous former deep coal mines with their many decade long after-effects of devastation, and brown coal strip mines as well as mines for extraction of other valuable minerals, all combine to complicate the present pattern of land development within the peripheral zones of Leipzig and Halle. Pollution of air and of surface waters in the vicinities of these cities is still aggravated by industrial waste, originating mainly from districts situated to the South and West of Leipzig and Halle.

CHANGES OF LAND DEVELOPMENT PATTERNS

The land improvement pattern of any area is subject to continuous changes. The above changes are the result of:

a) the annual cycle of weather;

b) other episodic phenomena due to various natural (i.e. climatic) or technological (e.g. damages) factors;

c) continuous changes of land use.

All the three above mentioned aspects are of consequence as concerns the inner peripheral zone, the most important of them being land use changes.

Differences in the land development patterns that are due to the seasonal weather cycle are of prime importance in agricultural land use in the case of municipal water supply and sewage systems, in transportation, and in utilization of local recreational areas.

They are manifested by the degree of pollution of air with gas and dust. Thus, in cases of cyclone weather, due to the high degree of air turbulence, a considerable expansion of area affected by emissions generated by industry

and transportation is noted. This causes, in fact, a reduction of emission values per square unit in absolute terms, but — spread over considerably larger area. During periods of anti-cyclonic weather, the dust sedimentation is limited to smaller areas around the emission sources with resulting higher degrees of pollution. At the same time, due to a reduced exchange action within the atmospheric basic stratum at reduced wind velocities, exhaust expand over larger areas. Penetration ranges and intensities are influenced each time by

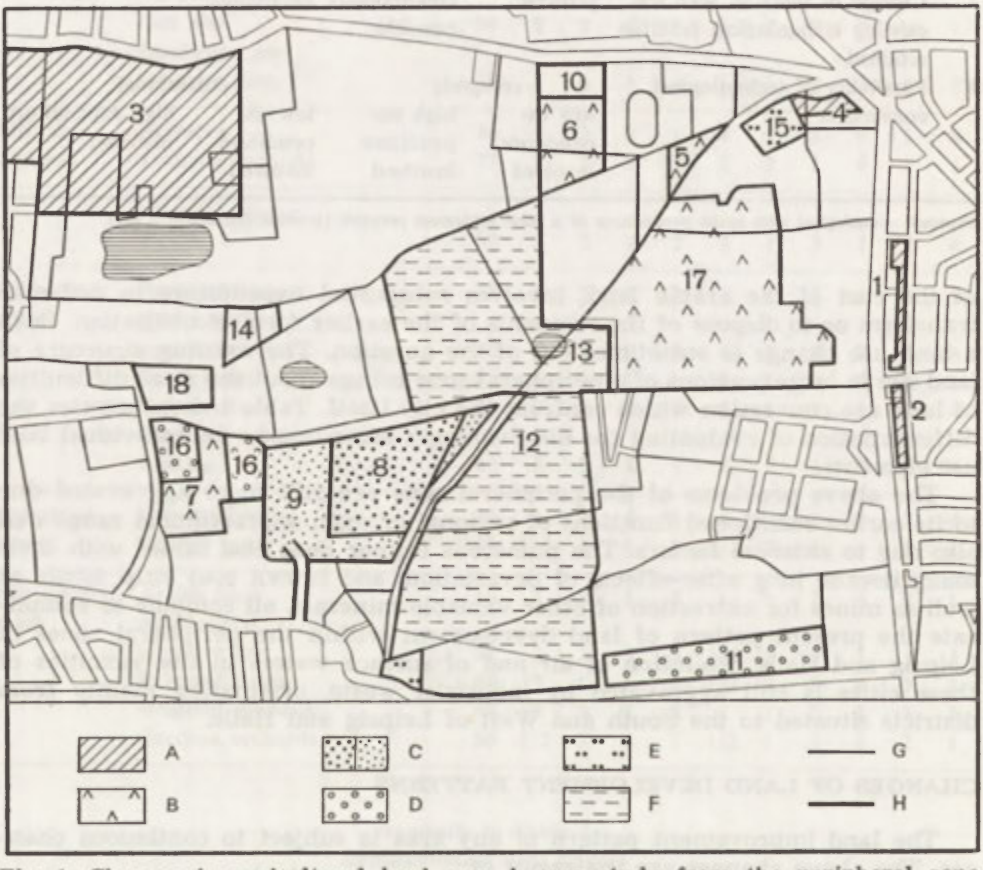

Fig. 1. Changes in agricultural land use: A case study from the peripheral zone of Leipzig, 1960–1971 (based on the city map of ca 1 : 15,000)

Changes from agricultural to other land uses:

1 — housing projects, 11 — storey high; 2 — housing projects, 5 — storey high; 3 — housing projects, 11 — storey high with accompanying facilities; 4 — temporary housing projects; 5–7 — allotment gardens, partially over mining grounds; 8 — waste dump, up to 40 m height, slopes partially stable; 9 — waste dump, up to 10 m height, partially overgrown; 10 — gardens; 11 — orchards

Other changes within agricultural land area:

12 — stationary irrigation facilities; 13 — recent collapse of mining grounds, partially filled with water; 14 — exhibition grounds; 15 — waste land in vicinity of a gravel pit; 16 — afforestry of devastated agricultural land area; 17 — afforestry of devastated agricultural land area on abandoned mining sites;

Others: 18 — mine heap, slope stabilization, exhibition buildings

A — Housing, B — Allotment gardens, C — Waste dumps, D — Orchards, afforesting, E — Waste land, F — Area of intense cultivation, G — position of 1960, H — changes after 1960

the rate of emissions and situation of the emission sources as to their height over the ground level.

The episodic occurrences include sudden weather breaks, heavy rainfalls, as well as excessively long time periods without rainfall. Furthermore they include extremely long time periods of ice cover and of ice drift over rivers and artificial water sheets, extremely low water level or overflooding in cases of high water in rivers, long lasting and abundant snowfall during frost periods, etc. The extreme weather conditions trigger a great many effects within the areas in question. They result in considerable disturbances over the city peripheral zone due to the high variability of land use. Such disturbances require high financial expenditure until brought under control.

It should be mentioned at this point, that after a 100-year period during which parts of the city and of the peripheral zone of Leipzig situated within the valley of the Weisse Elster and Pleisse rivers had been endangered by floods, no harmful high water tide has been noted there since 1954. This is the result of a systematic development of retention reservoires and water storage projects within the drainage basin of those rivers over the past 25 years.

TABLE 2. Loss and recovery of agricultural land (in %). The district (*Bezirk*) of Halle: 1954–1969 After G. Hesse, 1970

Type of land-use change	Halle (city)	Saal (*Kreis*)	Merseburg (*Kreis*)	Halle (*Bezirk*)
Mining	0.2	32.0	23.6	26.0
Industry	14.5	6.0	15.0	10.2
Solid waste dumping grounds	3.5	5.0	9.7	5.0
Agricultural production facilities	3.9	9.8	5.7	12.7
Housing	49.5	2.1	11.8	11.0
Water economy, partially forestry	19.9	15.1	12.5	12.7
Vacant and waste land	3.0	11.1	26.7	15.7
Others[1]	3.0	16.0	18.6	16.3
Loss (−)				
Recovery (+) due to land-use change[2]	12.5	2.9	−23.6	−9.3
Total area loss	100.0	100.0	100.0	100.0
Total area (ha)	1217	1918	3862	24,538

[1] Areas used for recreation, sport, training purposes.

[2] Agricultural areas occupied temporarily by other uses, e.g., by the construction of underground pipelines, temporary construction sites, also land reclaimed for agriculture. Example: Within the district (*Bezirk*) of Halle about 9.3 % of former farming land have been reclaimed by agriculture. At the same time 12.9% of agricultural land have been temporarily occupied by other uses.

Emergency cases in industrial production, as occurring in the form of the failures of treatment plants for gas and dust emissions, of leaks in tanks and pipe lines, of leaks out of agricultural silos, etc., bring temporary and also sometimes more long-lasting effects upon the land development pattern.

A specific feature of the land development dynamics in the peripheral zone consists in the continuous change of land utilization. The trend towards the augmentation of both the number of units to be located, and of the area covered by them, is represented by certain, although not all, categories of transportation, and by the types of uses related to water protection and water utilization,

housing, industry, storage, as well as the disposal and/or treatment of liquid and solid waste, and the extraction of minerals for building industry. A decreasing tendency, on the other hand, is characteristic of some local recreational areas, the agricultural areas, and partially — forest areas situated near a city. A specific, growing importance is also represented by the reclamation of waste dumping grounds, of abandoned strip mines, and ultimately the redevelopment of housing and industrial areas under socialist reconstruction programmes. All this adds up to a total transformation of land development patterns within areas of varying size. The mutually reinforcing processes result in growing advantages of the inner peripheral zone as well as in some of its disadvantages. The agricultural arable land, as shown in Table 2, present the most essential reserve for land use transformations within the peripheral zone and within isolated mining and industrial districts. This means from the angle of land development within the city peripheral zone not solely a diminishing of the agricultural production. Development of former farming areas cause changes in the spatial proportions more and more towards the disadvantages of vacant land. In parallel and in conjunction with the specific characteristics of the local recreational areas the open farming lands are of an essential importance for the recreation as well as for absorbing noise, odour and dusts. This is why the reduction of farming lands is accompanied by the growing need for planned and developed grounds for daily and week-end recreation which should not to be situated ever further from the city area.

DEVELOPMENT TRENDS WITHIN THE INNER PERIPHERAL ZONE

The changes occurring within the peripheral zones under observation over time periods shorter than a decade allow to draw conclusions concerning certain trends for the planned development of the land utilization patterns.

1. Expansion of functional interrelations between the city core and its inner peripheral zone is triggered by the technological progress, by the social development and by the changing demands of man with respect to his environment, as well as the production with respect to natural resources broadly conceived.

2. The location selection is determined partly by the natural conditions (sewage treatment plant — by slope; building materials — by the location of deposits; water power plant — by altitude; construction project — by the type of building grounds and ground water table). To a major part this is also preconditioned by present land use, e.g., in the case of development of housing estates, of road network, and of industrial areas. As far as the varying preconditions are concerned, there is a possibility that space scattering of the peripheral zone still increases. It may result in a decrease of the effectivity of the land development pattern. On the other hand, this explains the fact of growing expenditures aimed at the levelling-off spatial disproportions at the reclamation of the waste and devastated land of various type.

3. The city peripheral zone with its specific forms of expansion is as old as the city itself. It can be observed that even smaller, partly rural settlements develop such "areal growth forms", at least for the dumping of solid wastes, for the construction of sewage treatment plants, etc. This is why within one or more generations the cities have been reaching beyond their former peripheral zones.

The more scattered, however, are the areas of a high development value, with important infrastructural facilities or a high rate of change of the original natural environment, within the peripheral zone, the more difficult is the solution of tasks related to the spatial growth of a city. This is true of development

of compact housing and industrial projects, as well as related transportation facilities and local recreational areas. This means either assembling land for such projects *via* the costly rehabilitation of extensive areas which involve pulling down (or making functionally obsolescent) certain facilities of considerable investment value, or leap-frogging the present peripheral zone in the course of city expansion. In the latter case the areas of the former, peripheral zone remain within the expanded built-up area in the form of islands of an insufficient standard of functional utility. Thus, they present areas of potential disfunctions within the land development pattern of the growing city. At the same time they constitute a factor of a disproportional growth of the built-up area. Thus, one must give consideration at a time when there is still a sufficient area available for the expansion of the peripheral zone, to the needed changes in land use and the incorporation of still stable parts of the peripheral zone into the city. An essential contribution to the shaping of the optimal land development pattern would be effected in such cases not by subsequent rehabilitation of former, unefficient and piecemal development, but already at the stage of planning of such complicated and dynamic types of areas.

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RECREATIONAL AREAS WITHIN THE BERLIN AGGLOMERATION*

HEINZ SPITZER

INTRODUCTION

The successful development of our socialist state, particularly its economic development during the recent years, has ensured all the citizens more leisure time. This has been due to the reduction of working hours, shifting to the five-day working week, the extension of the minimum duration of annual vacations, and to other measures. The socialist society, which regards the man and his material and cultural needs as its focal point, has to take care of the rational and purposeful utilization of leisure time by each person according to his needs and according to general social possibilities. Leisure time should not only allow to regenerate energy but also to contribute to the development of the socialistic personality, individual abilities and talents. The socialist society has to prove its superiority in relation to capitalism not only to the field of economic productivity but also by providing the optimum conditions for every citizen with regard to the use he makes of his leisure time.

Daily and weekly recreation is of a great importance as concerns use being made of leisure time. It is of particular concern for the inhabitants of agglomerations who are exposed to such specific burdens and disfunctions as growing traffic intensity, deterioration of the environment, etc.

The Geographical Section of the Humboldt-University of Berlin was engaged during the past three years in the practical research project carried on for the Administration of the city of Greater Berlin and pertaining to the problem of near-distance (i.e. daily, weekly) recreation within the agglomeration of the capital. The aim of the research was to examine and to present the requirements resulting from the nature of the regeneration process especially the rational spatial organization of recreation. A particular task was to propose a model of optimal relations between the spatial pattern of work and residence and the distributon of local recreational areas within the Berlin agglomeration.

The main points of the above research were among others:

— determination of the demand for near-distance recreation;

— determination and evaluation of the capacities of the existing recreational facilities;

— determination of mobility of inhabitants with view to near-distance recreation.

A group headed by the author was assigned the task of compiling a large-scale general map covering the local recreational area within the Berlin agglo-

* This article is an extended comment to a map of recreational zone of Berlin. The map is not being enclosed for technical reasons.

meration. The map has to show the existing capacities, facilities and the accessibility of Berlin's local recreational areas. The map covered all areas situated within the range of 90-minute travel time by local public transportation.

LIMITATION OF RESEARCH AREA

The area represented on the map covers all communes situated within the 90-minute travel time by public local transportation from the centre of Berlin. The distance was calculated from a line which was represented by the sector between the stations Ostkreuz and Schönhauser Allee of the metropolitan surface railway. This stretch of the Berlin metropolitan surface railway (S-Bahn, formerly termed Ringbahn — circular railway) encloses essentially the core area of the inner city[1] and it provides the most rapid access for the inhabitants of the city centre to the majority of local recreation areas within and beyond the city. The time required to reach this sector of the railway from any point of the municipal core area by local public transportation, like a street car, a bus or the subway (U-Bahn) amounts to no more than 10 minutes on the average. The time to reach any local recreation area by the metropolitan surface railway has been determined within the duration of 10 minutes. The isochrones plotted on the map represent therefore the distance from the sector of the reilway between the stations Ostkreuz and Schönhauser Allee, less 10 minutes start time. Transfer time for changing the means of transportation has been determined at 5 minutes within and 10 minutes beyond the city as average. With the time-table valid for all the local public transportation it has proved possible to single out the four zones of accessibility of local recreational areas within the agglomeration of Berlin:

1. zone situated within 15 minutes travel time;
2. zone situated between 15-30 minutes travel time;
3. zone situated between 30-60 minutes travel time;
4. zone situated between 60-90 minutes travel time.

The limits of the time zones present the basic element of the map content. They continue the presentation area, while giving hints as concerns essential interrelations between the demand for local recreation, attitude towards the distance barrier and the degree of the recreation demand being met. The upper limit of 90 minutes walking time distance has been determined by a questionaire. A clear 60% of those questioned have named destination areas that were accessible within approximately 90-minute time. The outer limit of the area under examination reflects a cumulation of holiday travels by the inhabitants of Berlin.

DETERMINATION OF LOCAL RECREATION DEMAND

The determination of the number of potential holiday travels was based on the cartographic representation of the actual capacity and utilization of the local recreation areas. In Berlin, the capital of the GDR, the present estimations show that up to 35% inhabitants seek local recreation and head, over the weekends, for the local recreation areas within and beyond the city. Those looking for off-time and week-end recreation account, according to the research accomplished by a team of the city administration, for 8–10% of the entire population

[1] The capital district of the GDR, Berlin, incorporates the three structural types of sub-regions — the inner core area, the core surrounding zone, the city peripheral zone — each representing specific local recreation requirements. See also A. Zimm, H. Rumpf and J. Lange (1971).

as regards the off-time, and for 30–35% thereof as regards the week-end recreation (Zimm, *et al.*, 1971, p. 783). When related to the present population total of 380,000 inhabitants in search of recreation. With view to the communes surrounding Berlin, it has been assumed that the figure of those in search for recreation in local areas in industrial communes and in those of more than 5000 inhabitants amounted to no less than 20% of inhabitants. As concerns rural localities and those below 5000 inhabitants, the figure of 12% has been accepted as the basis for the estimation of the number of local recreation seekers. According to the above representation, the area presented on the map has been based on the isochrone of 90-minute travel time by local public transportation as from the city centre of Berlin. The area situated between the limits of the city of Berlin and the outer limit of the 90-minute zone is inhabited by 427,000 people. With the 20% or 12% rate, this results in 86,000 recreation seekers. The total of the potential recreation seekers within area examined — the capital of Berlin together with its surroundings (population 1.5 million) — amounts to 465,000 people. The above figure helps to visualize the scope and importance of the task of optimizing spatial relations within the local recreation areas of Berlin, for the benefit of the man.

The capital of the GDR, Berlin, ranks among those few large cities offering highly advantageous local recreation possibilities within the city area. The south-eastern outskirts of the city enclose, e.g., the forest and lake region of the *Grosser* and *Kleiner Müggelsee* which is highly attractive from the stand point of landscape qualities and very well suited for local recreation purposes. This fact has the effect that a considerable part of the Berlin local recreation seekers remains over the week-ends within the city boundaries. Some 46%

TABLE 1. Local recreation demand balance within the Berlin agglomeration — as related to the zone of 90-minute travel time by local public transportation from the city centre

	Sub-regions	Area	Population	Recreation seekers	
		sq.km	in 1000's	total in 1000's	bath demand in 1000's
1.	Berlin	403.1	1,081.9	378.7	226.2
1.1.	Including commuters	—	—	204.5	122.7
2.	Towns and communes within the 30–60 minute isochrone	1,028.7	228.7	46.5	27.9
3.	Towns and communes within the 60–90 minute isochrone	2,508.8	198.6	39.8	23.9
	Sub-regional total	4,012.6	1,509.2	465.0	278.0

out of the assumed 380,000 recreation seekers of the capital travel to the extensive local recreation areas within the city, while nearly 54% of this number look for recreation beyond the city boundaries.[2]

Water sports, water touring, and above all bathing are of great importance as concerns local recreation within the agglomeration of Berlin. It is estimated that at least 60% of visitors of the local recreation areas take open air baths. The advantageous possibilities of bathing in the open as offered by Berlin and the environments of the city effectively add to increase the attractiveness of its recreation areas.

[2] See also O. Gloger (1966).

WATER AREAS IN THE LOCAL RECREATION LANDSCAPE WITHIN THE BERLIN AGGLOMERATION

Water areas are of great importance as an element of the local recreation landscape within the Berlin agglomeration. The recreation value of more than 100 lakes within the area depends, apart from other factors, on the quality of water and on the utility values of the lake shore.

The categories of bathing qualities according to the directives of the water management authorities of the GDR, as concerns the purity of surface waters and principles of their classification are the following:

Quality class	Characteristics
I	particularly clean waters
II	normal waters
III	polluted waters
IV	use of waters forbidden

Quality class I water is suitable basically for all use, and meets highest bathing requirements. Quality class II water is moderately polluted, it is not suited to the municipal supply requirements, while still offering bathing possibilities. Quality class III characterizes polluted water, still suitable for various industrial purposes, but only partly suitable for bathing. Water with an impermissible degree of pollution, within the quality class IV, offers no normal hydro-biologic self-purification potential, and is off-limits for any bathing purposes.

Only a few out of the more than 100 lakes within the area examined demonstrate features of the quality class I. The overwhelming majority fall under the quality class II. It should, however, not be ignored at the same time that a great part of the "normal waters" tends towards the quality class III, i.e., the polluted waters. The rather frequent draining non-treated or insufficiently treated sewage into the waters, has resulted, together with the large-scale water fowls breeding, to affect the bathing possibilities of certain lakes in a negative way. The socialist Land Management Bill of the GDR that was passed in 1970, presents a decisive legal basis for the reclamation, maintenance and expansion of effective recreational potential of the nature. It also sets controls for further pollution of waters of particular importance from the standpoint of local recreation.

BATHING CAPACITIES AND BATHING DEMAND

As concerns the determination of the bathing capacity of waters, the value of 6–10 sq.m. of the lake shore per bathing person has been accepted as the starting point with regard to large area waters with in- and outflow, with the average depth within the near-shore zone of up to 50 m (Gloger, O., 1966, p. 34). Any overcrowding beyond the above limit, over a long time, by local recreation seekers, would have a deteriorating effect, and in extreme cases even forfeit of the recreational qualities of waters or a sector of the shore in question.

Within the area examined the bathing capacity of all waters amounts approximately to 60,000 persons, while accepting the above specified average density as the basis. Nearly half (44.6%) out of this figure falls to the southern vicinities, while eastern (29.1%) and northern (26.3%) account each for some 1/4 of the total bathing capacity. The present capacity as concerns the bathing potential under a normal density, is confronted by the maximum demand of 160,000 persons.

A comparison of figures makes it clear that the vicinities of Berlin, so notable for its attractive forest-and-lake landscape are overcrowded with local recreation visitors who seek bathing possibilities, particularly in the city zone and over week-ends.

This is represented on the map in the form of diagram symbols. The horizontal length of the diagrams marks the bathing capacity, and the height — the maximum demand during the week-end days. The basis for the value scale amounts to 300 visitors in search of a bathing place per every one mm of side length. The map shows that all the lake areas within vicinities of Berlin examined are already overcrowded in relation to the normal density as assumed for a week-end during the season.

This is, however, not to say that upper bathing capacity of the lakes within the vicinities of Berlin have already been reached. With suitable expenditures one could procure, e.g., within the district of Frankfurt/O. new bathing capacities on many of lakes there. One can distinguish three levels of expenditure : negligible (I), expenditure (II) and high (III).

The expenditure level I involves development of a narrow land strip in order to expand the bathing places available or to establish new ones. The beach area can be provided with no earth moving, or by re-shaping gentle shopes.

In the case of expenditure level II, the requirements involve already provisions to be made for a not very wide strip of beaching facilities. Muddy shore stretches must be improved with the use of some surface covering material. The making of a beach area requires the levelling-off of steeper slopes, as well as the removal in some instances, of week-end cottages and similar buildings.

The expenditure level III involves the expansion of the bathing facilities available, and/or establishing new ones which necessitates the founding of a dense and wide strip of sun-bathing area. This demands in turn, a major job of filling the under-stratum of marshy meadows and swamp land. As concerns beach area, steep slopes and/or dense building areas within the shore zone must be disposed with.

The initial calculations have shown that such measures would yield within the area examined no more than bathing facilities for 100,000 holiday visitors seeking beach recreation. A difficult problem faced presents the densely built-up area along the shores of lakes that are of particular value from the close distance recreation angle. It is above all due to the one-time capitalist development that many lakes within the peripheral area of Berlin are partially or wholly lost for public use, as their shore strips are occupied by building lots. Thus, the lakes listed below have their shores covered to a high extend by buildings.

Name of lake	Percentage of shore line occupied by buildings
1. Peetz-See	80
2. Wandlitz-See	72
3. Scharmützel-See	65
4. Werl-See	61
5. Stolzenhagener See	55
6. Grosser-Müllroser-See	43

The provisions of the building code as enforced today require a strip of the minimum width of 15 m to be left vacant for public approach to the lake-shore.

FACILITIES FOR LONG-TERM RECREATION WITHIN THE AREA EXAMINED

The area is noted for the local and long-term recreation forms being mutually superimposed. The vicinity of Berlin abounding in forests with plentiful and enchanting waters, offers many established attractions from the angle of providing facilities for vacationeering-camping sites, factory and trade union owned accommodations as well as children's vacation camps.

A steadily increasing importance is represented by the camping sites offering admittance to visitors from all of the GDR as well as to those from foreign countries. The camping sites have at present a total capacity of 31,000 persons, within the entire area. The top ranking one are situated to the South and South-East of Berlin. They stretch along the lakes within the south-eastern district of the city, and further into the districts of Königs Wusterhausen and Fürstenwalde. They are incorporated into the large-area nature preservation grounds expanding from the Berlin district of Köpenick eastwards up to Fürstenwalde and southward into the district of Teupitz — Gross-Köris. The North is sparsely used for camping sites in comparison with the above districts.

Apart from the camping sites, it is the children's vacation camps the importance of which increases, as far as long-term recreation facilities within the Berlin vicinities are concerned. The total accommodation capacity of such children's vacation camps amounts to 20,000, and most of them are made use of groups of visitors during the season.

During the recent years, also the accommodation capacities of the factory and trade union owned facilities within the vicinities of Berlin have been greatly expanded. They offer at present the total capacity of 10,000. From the angle of long-term recreation for the young youth hostels, hiking shelters, tourist shelter homes, and other facilities are of importance. At their present time their total capacity is 1600 within the area examined.

The total of accommodation offered by facilities for long-term recreation amounts to nearly 62,000.

SUMMARY

The questions concerning local recreation within the agglomeration of Berlin, presented briefly in the paper, help to make it clear that the task of a purposeful development of local recreation would require the participation of geographical sciences. In the development of scientific basis for the territorial planning thematic maps are of considerable importance. The multiple possibilities of applying methods of thematic cartography are far from being exhausted with regard to this field of work. The thematic map is capable of contributing as a basic means of planning to the rational shaping of local recreation management.

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STRUCTURE AND DEVELOPMENT TRENDS OF THE CRACOW AGGLOMERATION

Bronisław Kortus

The Cracow urban-industrial agglomeration includes the city of Cracow (586,000; 120,000 industrial employees in 1970) and a few other industrial towns: Skawina (population 15,900), Wieliczka (13,600) Niepołomice (5200) and others, with a total employment in industry of over 10,000.

The Cracow agglomeration ranks fifth in Poland in population size and fourth in regard to the number employed in industry (Table 1). It is relatively

TABLE 1. Poland's largest urban-industrial agglomerations, 1966

Urban-industrial agglomerations	Population (in thousands)	Employment in industry (in thousands)
1. Upper Silesian	2718	725
2. Warsaw	1623	295
3. Łódź	905	263
4. Gdańsk	600	100
5. Cracow	560	115
6. Wrocław	492	97
7. Poznań	480	103

Source: S. Leszczycki, P. Eberhardt, S. Heřman, Aglomeracje miejsko-przemysłowe w Polsce 1966—2000 (Urban-industrial agglomerations in Poland 1966—2000), Biul. KPZK PAN, 67, Warszawa 1971.
Data for Cracow agglomeration calculated by the author.

TABLE 2. The development of industry in the Cracow agglomeration, 1938–1970 (according to the number of employed in industry)

Years	The city of Cracow (in thousands)	Cracow's satellites (in thousands)	Cracow Agglomeration (in thousands)
1938	20,7	3,4	24,1
1946	28,7	3,4	32,1
1956	78,2	6,8	85,0
1960	89,5	8,5	98,0
1965	104,5	9,6	114,1
1970	120,0	10,5	130,5

young in comparison to that of Warsaw or Łódź as it developed mainly after the Second World War as a result of the industrial development in Cracow proper and its satellites, mainly Skawina (Table 2, Fig. 1).

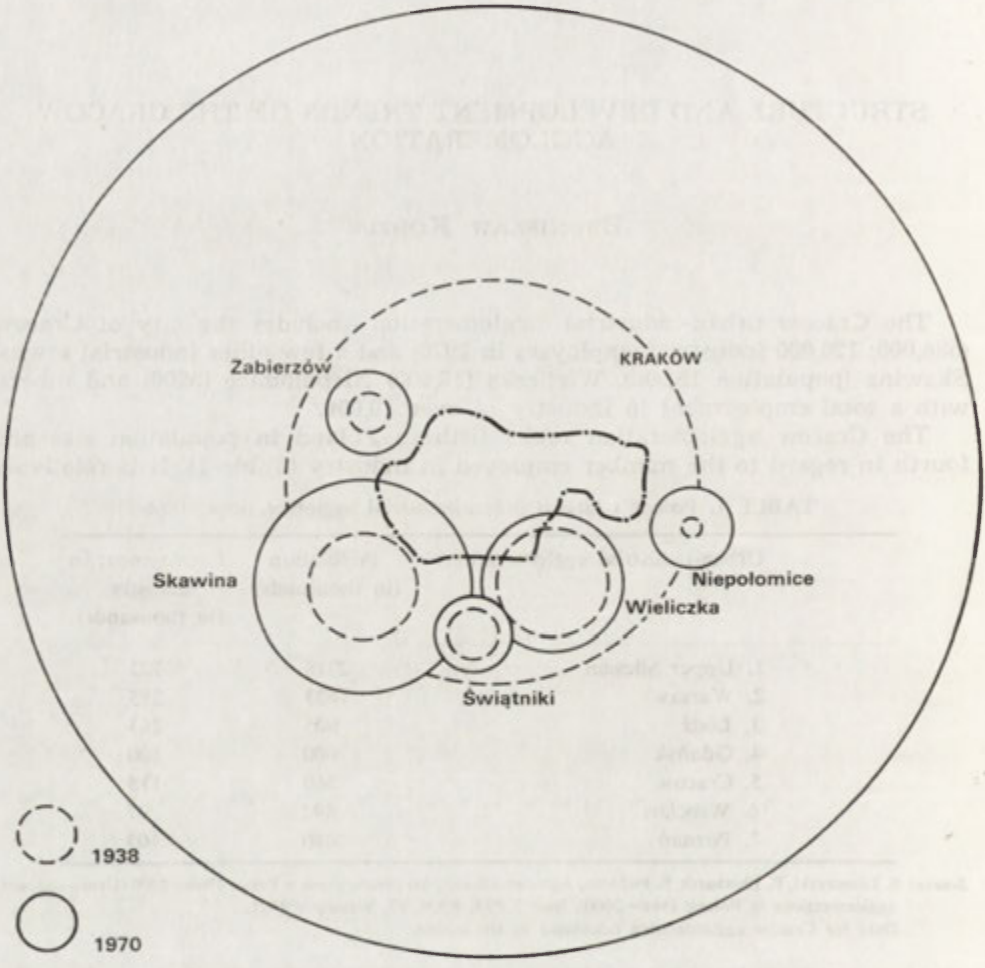

Fig. 1. The development of industry in the Cracow agglomeration, 1938–1970

The delimitation of the Cracow agglomeration is somewhat complicated. Planners, for example, include the wholes *poviat* of Cracow and parts of Bochnia, Chrzanów, Proszowice and Wadowice *poviats* (Fig. 2). The area of such an agglomeration is equal to 1500 km², its population to 835,000 (1970), and the number of employed in industry equals to 135,000. In my opinion the range of such an agglomeration is too large while by 1990–2000 it will probably be too small.[1]

At this point we should discuss the most significant elements in the development of Cracow's economic structure. Up to the Second World War Cracow

[1] K. Bromek (1966) on the basis of land use structure has determined the size of the urban agglomeration of Cracow as 500–600 sq. km.

Fig. 2. Cracow urban-industrial agglomeration

1 — agglomeration boundaries, 2 — voivodships boundaries, 3 — *poviats* boundaries, 4 — main rail-roads

was mainly a centre of education, science, art, and place of historical monuments. Its industrial functions lagged far behind service, trade, educational, cultural, tourist functions. Historical tradition was the dominant force. During the postwar period, however, significant changes in Cracow's economic structure took place. In 1931 the number of people employed in industry and construction was equal to 32.6%. of the total number of people employed in Cracow. In 1950 it was already 44.2%. By 1960 it was equal to 53.4% and in 1970 to 57%. Cracow became a large industrial centre and a huge construction site. The number of people employed in industry and handicraft went up from 30,000 in 1938 to 120,000 in 1970; that is four times. The population of the city doub-

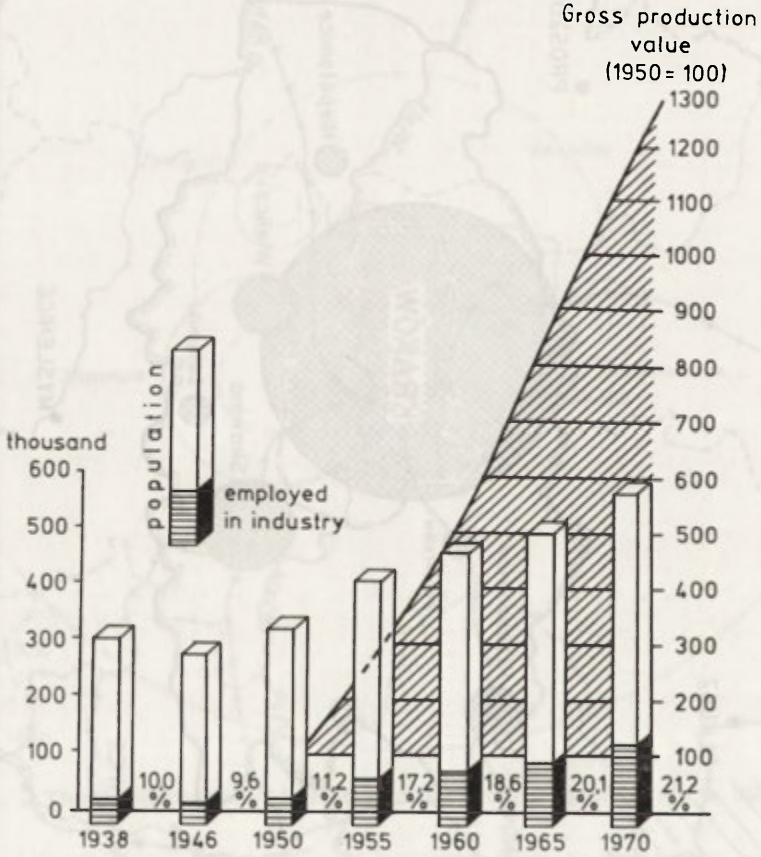

Fig. 3. The growth of industry in Cracow, 1938–1970

led during that period from 260,000 to 586,000. In 1970 Cracow ranked third among Polish cities in regard to the number of population. Those facts and figures point to the dynamic development of Cracow during the postwar period. No other city in Poland, with the exception of Warsaw, did undergo such dynamic development. Industry was the driving force of Cracow's growth, and today it is one of the most important functions of the city. This however does not mean that Cracow lost its traditional functions. It is the country's second cultural and scientific centre and one of Europe's major tourist centres.

The development of Cracow after the Second World War was the function of its industrial development. If we take the percentage of people employed in industry as an index of industrialization, it would mean that the industrialization level of Cracow went up from 10% to over 21% during the years 1938–1970 (Fig. 3). The rapid industrialization as it is widely known, has been a characteristic feature of the postwar Poland. While, however, the index of industrial growth (measured according to production value) during 1950–1970 was equal to 760 for the country as a whole, it amounted to 2100 in the case of Warsaw, 1300 for Cracow, 795 for Wrocław, 733 for Poznań and 440 for Łódź. The postwar industrialization of Cracow was much faster than that of other Polish cities (except Warsaw) and it was twice faster than the national average.

The main component in the industrialization of Cracow was the Lenin Steel Works, the biggest industrial investment in People's Poland. Out of its more than ten locations considered the one near Cracow was selected due to such factors as: proximity of Silesian coal, the presence of the Upper Silesia–Cracow–Przemyśl–USSR railway line through which coal and iron ore are supplied and large reserves of manpower in the nearest hinterland. Apart from that Cracow's scientific institutions, particularly the Mining and Metallurgical Academy could provide qualified personnel and research facilities. The proximity of large city and the cultural centre was also an important factor from the point of view of the social adaptation of migrants to urban conditions of living and work. In 1946–1960 migrations to Cracow amounted to 100,000 persons, out of which 60% came from rural areas.

In 1973 the Lenin Steel Works produced 6.5 million tons of steel, 50% of the national total. Over 30,000 people are now employed in the still expanding Works.

Thus the Lenin Steel Works became the dominant element of Cracow's industrial structure. Its share in total industrial employment is equal to 26% and in value of industrial production — 46%.

Apart from the Lenin Works about 20 large and 50 smaller industrial plants were constructed in Cracow since 1945. A number of already existing factories were expanded. As a result Cracow became one of the biggest industrial centres in Poland, ranking after Upper-Silesia, Warsaw and Łódź. The industrial structure of Cracow has been also subject to major change (Table 3). Before the Second World War machinery (31.2% employed), food processing (28% employed) and chemical industry (10% employed) were dominating. The metallurgy, which was added to the three traditional branches, became today dominant one. According to the location index which reflects industrial specialization, Cracow is a significant metallurgical (5.4) and printing centre (3.0). It also specializes in chemical, electrical engineering and leather industries. However, the role of machinery, paper, textile, and food processing industries diminished in comparison to that in 1938. According to the principles of comtemporary industrial structure a decline in the machinery and electrotechnical industries (1.4 to 0.8 and 3.5 to 1.3) is a negative phenomenon. It was caused by the fact that priority was given to steel industry, while other branches were relatively neglected.

In comparison with Wroclaw and Poznań, cities similar to Cracow in size and function, Cracow's machinery and electrical engineering industry accounts for a small percentage of its industry, only 19.2%. In Poznań, Wrocław and Warsaw the above mentioned percentage is accordingly 51.5%, 54,8% and 55.3%. The situation in Łódź is similar to that in Cracow (19.8%). That is why the contribution of the so-called "new branches" (electrical engineering, chemical) to industry as a whole is equal to 66% and 64% in Poznań and Wrocław

whereas only 28.1% in Cracow. Cracow on the other hand is a bigger university and industrial research centre. In 1970 the number of employed in such specialized research institutions in Cracow was equal to 16,000. In Poznań it was equal to 11,000 and in Wrocław to 13,000. In this respect Cracow ranks 3 in

TABLE 3. Branch structure changes in Cracow's industry, 1938–1970

Industrial branches	Employment (%)		Location index*	
	1938	1970	1938	1970
Energy	3.3	5.0	0.3	0.4
Metallurgy	—	22.8	—	5.4
Metal and machinery	23.5	20.3	1.4	0.8
Electrical engineering	7.7	6.9	3.5	1.3
Chemical	10.0	9.0	1.4	1.4
Mineral	5.5	6.0	0.5	0.9
Wood	2.6	1.7	0.3	0.3
Paper	4.5	1.3	2.0	1.0
Printing	6.3	3.6	3.5	3.0
Textile	1.9	1.2	0.1	0.1
Apparel	6.1	4.3	3.0	1.1
Leather	4.3	4.6	2.7	1.4
Food	23.6	11.1	2.2	1.0
Other branches	0.7	1.8	0.9	1.3
Total	100.0	100.0	×	×

Source: Statistical Yearbooks of the Central Statistical Office and the calculations made by the author.

*) Location index (W_{lok}) was calculated according to the following formula:

$$W_{lok} = \frac{Kx/K}{Px/P},$$

where: Kx/K — per cent of employment within a given industrial branch to total employment in Cracow's industry, Px/P — the respective quotient for the country as a whole.

the country, after Warsaw and the voivodship of Katowice. In accordance, various processing (rather than primary) industries should be developed in Cracow, especially those requiring close links with scientific and research institutions. However, Cracow's scientific potential is to a higher degree connected with non-local, rather than with the local industry.

The one sided development of Cracow's industry, where metallurgy accounts for 42% of the total production value and 23% of the number of employed, was its negative effects. Cracow is becoming a mono-industrial centre, which reduces the city's localization advantages. The change of the industrial specialization index for Cracow is as follows: 1946 — 0.44, 1956 — 0.28, 1965 — 0.25, 1970 — 0.25. This means that Cracow's industrial structure is becoming more similar to that of the whole country. This in turn points to the dominance of heavy industry; mainly metallurgy.

At the same time there are sound economic reasons for future expansion of the Lenin Steel Works. This results in certain discrepancy (mainly on the labour market) between metallurgy and processing industries, especially the "developing and research oriented" branches.

The industrial structure of Cracow's hinterland is also dominated by heavy industries: building materials (23% of the total number eployed), metal and machinery industry (22%), aluminium mill plus power station (18%) and chemical industry (10%). The common feature of industrial growth in Cracow and its hinterland was the emphasis on primary metal — steel and aluminium pro-

duction. In 1970 the Lenin Steel Works (together with its cement plant) and the aluminium mill at Skawina accounted for 30% of the total number of industrial employees and 50% of the production value within the agglomeration. Therefore, the Cracow agglomeration is undoubtedly specializing in metallurgy. In 1972 it produced 45% of the country's steel and 51% of its aluminium.

TABLE 4. Cracow — structure of employment, 1970

Branches of economy	Employment (in thousands)	%
National economy (total)	330.6	×
Non-private sector (total)	307.6	100.0
industry	114.3	37.1
construction	60.5	19.6
agriculture and forestry	1.9	0.3
transportation	24.0	7.8
trade	26.3	8.5
education, science, culture	33.3	10.8
others (health service, administration, etc.)	39.9	15.9

Source: Statistical Yearbook of Cracow 1971, MUS, Kraków 1971.

An important locational characteristic of Łódź and Warsaw agglomerations is their situation in the centre of the country; in the case of Cracow an equivalent factor is its proximity to the Upper-Silesian Industrial District. This fact mainly has determined the industrial structure and the rate of growth of the Cracow agglomeration. In the industrial structure there prevails the heavy, resource-oriented industry (the iron-consuming metal and machine industry, metallurgy, building materials industry, soda and artificial fertilizer production), the development of which is based on the Upper-Silesian coal and metallurgical base.

During the intensive period of the country's industrialization after the Second World War, Cracow as a peripheral industrial centre of that type, acquired a number of industrial investments which the Upper-Silesian Industrial District was unable to accomodate. The localization of steel and aluminium works in Cracow and it's satellite centre, Skawina, is a concrete example of a policy of passive deglomeration in regard to the Upper-Silesian Industrial District (according to a former plan the steel works were to be loacated near Gliwice and the aluminium works in Jaworzno, both within the Upper Silesia-agglomeration).

The index of spatial potential[2] can be used to illustrate Cracow's size as an industrial centre in comparison with other big industrial centres of Poland. Table 5 and Figure 4 contain the appropriate results.

It may be stated that Cracow's industrial potential measured by the value of fixed assets in industry is second only to the Upper Silesian potential. The traditionally applied index-value of fixed assets in industry — M puts Cracow's industry as being 5 times smaller than that of Upper-Silesian District (20:100), but in terms of the index of spatial potential — V Upper-Silesia's ascendency

[2] Cf. Z. Chojnicki, *Zastosowanie modeli grawitacji i potencjału w badaniach przestrzenno-ekonomicznych* (Sum.: The application of gravity and potential models in spatial economic research), Studia KPZK PAN, 14, Warszawa 1966.

over Cracow is not even double (58:100). Here we can see the advantage of Cracow's location close to Upper-Silesian Industrial District. It can be hypothesized that Cracow's big opportunities for industrial expansion or its "industrial growth potential" have been in its spatial proximity in relation to Upper Silesia.

TABLE 5. The industrial spatial potential of selected industrial centres in Poland in 1960 (relative values)

Industrial centres	Value of fixed assets in industry (M)	The spatial potential (V)
Upper Silesian Industrial District	100	100
Łódź	21	53
Warszawa	20	36
Kraków	20	58
Wrocław	13	40
Poznań	10	31
Tarnów	6	36

The scientific and cultural functions art following those of industry as far as the number of employees is concerned while bearing the first place among the non-productive (service) functions. At the same time they constitute the oldest functions, called to life by the foundation, in 1364, of the Jagellonian University, and they play a prominent role both in the city's functional struc-

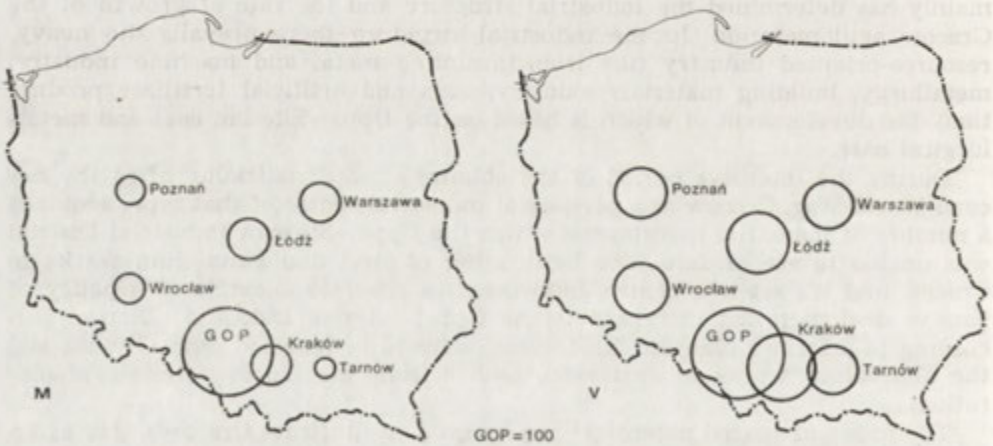

Fig. 4. Size of the selected industrial centres of Poland in terms of their spatial potential *V* (as compared with their size according to the index *M*), according to the value of fixed assets in industry, 1960 (GOP = Upper-Silesian Industrial District).

ture and on the national scale, with Cracow taking the second position only after Warsaw. A strong development of higher education (11 schools at the university level with over 50,000 students) has stimulated the growth of scientific institutions, affiliated to the Polish Academy of Sciences as well as numerous industrial research centres. As far as the number of persons employed in these institutions is concerned, Cracow is the country's number three centre, after

Warsaw and the Katowice voivodship. With the post-war development of industry and construction Cracow became an important scientific and research centre meeting the needs of southern Poland's coal mining and other industries. The territorial range of Cracow's influence as a centre of university education, the science and cultural functions encompasses entire Southern Poland. In the West it meets the corresponding zone of influence of Wroclaw (in the Opole voivodship) and that of Warsaw in the North (in the Kielce voivodship), while in the East Cracow's sphere of influence encompasses the Rzeszów and part of the Lublin voivodship.

Another function of Cracow on a supra-regional, national and to a large extent international scale is it's function as a tourist centre. The tourist movement to Cracow which in the inter-war period stood at about 80,000 persons per year, has passed presently the 2,000,000 persons per year mark. Foreign tourists constitute about 10% of the total number of visitors.

The following elements make Cracow a major tourist attraction:

— numerous and well preserved historical and art monuments;

— widely known cultural institutions, especially museums containing valuable and varied collections;

— the proximity to such tourist centres as the National Park of Ojców, the Wieliczka Salt Mine and the Oświęcim (Auschwitz) Museum of Martyrology;

— a convenient location from the transportation point of view.

There are 713 historical monuments in Cracow, both secular and sacral — a record number in comparison to other Polish cities. Out of Poland's 52 monuments graded in the "0" group, that is monuments of the highest artistical and historical value on an international scale, Cracow has 11, outnumbering by far Poland's remaining regions and cities.

Finally, Cracow's transportation function is also one of supra-regional importance. It's railroad junction, the airport and partly its highway junctions are of national importance.

The expansion of city's economy and population has caused a substantial increase of transportation demand. A new complex of railroad terminals has been established in the eastern part of the city to handle the transportation needs of the Lenin Steel Works. It is connected by a new by-way with the Upper-Silesian–Przemyśl railroad by-passing the city. The total transport volume was 34.7 million tons in 1972 (the in-coming tonnage was 25 million tons). In this aspect Cracow is ahead of Poland's other railroad junctions, with the exception of course, of the Upper-Silesia. About 70% of Cracow's goods transportation is connected with the Lenin Steel Works (26 million tons in 1970).

Intraregional flows (within the Cracow voivodship) account for about 20% of total tonnage handled, while inter-regional flows (to other voivodships) account for 55% (in this Katowice voivodship for about 30%) and flow to and from abroad — for about 25%. These proportions confirm the existence of strong economic linkages of Cracow on the national and international scale.

About half of Cracow's railroad and bus passenger trips are attributed to home-to-work commutation. The large labour deficit due to the constant development of industry and construction makes this kind of commutation necessary with 50 thousand (in 1970) persons travelling daily there and back. After Warsaw, it is the highest number of commuters within a single city in Poland.

The ranges of this commutation in the Western (up to Krzeszowice) and Eastern (up to Bochnia) directions clearly demarcate the Cracow agglomerations sphere of influence from that of Upper-Silesia and Tarnów. In the Southern and Northern directions Cracow's commutation ranges are fairly small, and

in the South most of the commutation is headed in the direction of Skawina and Wieliczka.

Within Cracow's close vicinity there exist several small industrial centres which might be called it's "industrial satellites" (Wieliczka, Skawina, Niepołomice, Zabierzów and others). Like in Cracow, the industrial growth of these towns is mainly a post-war phenomenon. Skawina, where in 1954 Poland's first aluminium mill was erected and later a big power station (570 MW), has developed the most. Wieliczka on the other hand gradually ceases to be Cracow's industrial satellite. Its salt mine is nearly exhausted thus Cracow's soda plant takes its brine from a more distant Bochnia. Wieliczka's historic mine is presently mainly a tourist attraction as well as a health resort (an anti-asthmatic sanatorium). However, as a town Wieliczka is still Cracow's satellite since over 6000 persons (40% of the total population) commute daily from there to Cracow.

We should bear in mind that in the near future Cracow's strong and vigorous industry will cause the establishment and development of further industrial centres in it's vicinity. For a few years now we may observe in Cracow — as in other large industrial centres — difficulties in the further development of industry due to labour shortages, a deficit of water and so on. One of the ways of overcoming these difficulties is the establishment of branches of Cracow's larger industrial plants in the voivodship area where labour force is still available, that is mainly in its Eastern and Southern parts. In 1968 there was established in Bochnia a branch of the Lenin Steel Works. In the years 1969–1970 branches of other factories, producing transportation equipment, measurement apparates, etc. were established in Sucha, Limanowa and other places. The development of the Tin Plate Packing Factory in Brzesko was based on plate produced in the Lenin Steel Works. The voivodship authorities encourage other large industrial plants which meet growth thresholds within the city to establish branches in smaller towns of the voivodship. This is undoubtedly the right kind of policy since it is in accord with the deglomeration policy of Cracow's industry as well as with the policy of stimulating economic expansion in less developed areas. In the plants that have been established as a result of the deglomeration policy of Cracow's industry by 1972 about 3000 persons were employed.

The spatial growth of the agglomeration of Cracow is headed in the Western (Trzebinia) and Eastern (Bochnia–Tarnów) directions along important transport lines: the Upper-Silesia–Cracow–Rzeszów–Przemyśl electric railroad and highway and the natural gas pipeline. The Eastern direction of expansion must be regarded as proper and it is stimulated by appropriate localizational decisions — in places like Bochnia, Brzesko and others. The same cannot be said about the Western direction where the growth should be stopped. The area situated between Cracow and the Upper-Silesian Industrial District is especially attractive for industrial development due to the already existing technical infrastructure (transport, energy and other lines) as well as a possibility of cooperation with both the industries of Upper-Silesia and Cracow. But an integration of the Cracow agglomeration of over 700,000 inhabitants with that of Upper-Silesia with its over 2 million population should not be allowed. Such an occurrence would worsen the bioclimatic, health and sanitary conditions in that area. The Cracow voivodship aims at preserving the biological protective zone between Cracow and Upper-Silesia, that is, agricultural and forest areas which are industrialized only to a very small degree. The future joining of the Upper-Silesian and Cracow agglomerations is unavoidable but the connecting area should be as narrow as possible — in other words — only along the transport routes.

The spatial development of the agglomeration core — Cracow — will head

beyond the city's present administrative boundaries. All the vacant land between Nowa Huta and old Cracow as well as at the outskirts of the city's present territory will soon be used up. The city's future development in the Eastern direction is closed by the Lenin Steel Works, while development in the Northern direction is not advisable because of valuable soils there. In the Western direction the terrain is partly unsuitable for construction, and on the other hand, it is partly occupied by atractive recreation areas, which should be protected. Thus, there remains only the Southern direction which is designated for the city's urban development. The present satellite-towns of Skawina and Wieliczka will probably be incorporated into the city.

The industry of the Cracow agglomeration needs serious reconstruction and modernization of its branch structure. As we saw before, the post-war development was mostly characterized by the growth of the basic, heavy industries — mainly steel and aluminium works. These works were accompanied by building materials plants (a cement plant in Nowa Huta, brickworks and concrete plant in Cracow and Skawina). Thus independently of a further expansion of the Lenin Steel Works (what should partly be accomplished by way of deglomeration of its certain sections outside of Cracow) the processing industries, especially machinery and electrical engineering, should be developed more vigorously, using the considerable local scientific and research base.

Lately, more and more attention is being paid, within the agglomeration and its surroundings, to the protection of man's environment.

Due to the location of a large part of the city in the valley of the Vistula river, Cracow has a very unfavourable micro-climatic conditions. Because of a lack of winds there often may be observed a smog residue over the city. It should be aimed, of course, at limiting or eliminating the sources of pollution. The Lenin Works have some marked achievements in this field. It has limited air pollution and the pollution of the Vistula river by sewage. Nevertheless, the mill still constitutes a threat to the Niepołomice Forest which lies more to the East. The industry as well as communal heating system should gradually switch from coal to natural gas which will be supplied by the pipeline from the Rzeszów voivodship (lately natural gas has also been discovered in the Bochnia area).

The Upper-Silesian Industrial District, especially its Eastern part, still constitutes a danger as the pollution of air and water in the Cracow agglomeration is concerned. Due to Western and North-Western winds which are dominant in this area much of Upper Silesian smoke and dust reaches Cracow. Also the Vistula river is polluted by the industry of the Katowice voivodship (mainly through the Przemsza river) and by the industry of the Western part of the Cracow voivodship.

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COMMUNE CATEGORIES. A METHOD OF DETERMINATION OF CONDITIONS AND TENDENCIES IN THE HALLE-LEIPZIG AGGLOMERATION

CHRISTA ROSENKRANZ

The problem of long-term formation of the settlement network plays an important role in the framework of research on spatial structure. It is necessary in the socialist system that a planned settlement network is based upon the following objectives:

— continuous improvement of labour and living conditions of the working class;

— increase of national income.

The increasing importance of solving the problems connected with rational formation of the settlement network may be illustrated by the fact that all the socialist countries deal with those questions with special emphasis laid on:

— improvement of the hierarchic system of macrostructure of the settlement network. It is planned that 3–4 fundamental ranks will build up the structure of a settlement network, i.e., supra-regional centres, regional centres, smaller centres and other settlements;

— determining scientifically based commune (*Gemeinde*) categories [1] as fundamental for the long-term development, taking into consideration territorial differencies.

The aim of this paper is to give an account to the problem of commune categories. To achieve this the following points have to be clarified:

— demonstration of a method of evaluating the commune categories according to differential factors in the field of spatial structure;

— definition of spatial differences within communal categories on the basis of structural type of an agglomeration;

— presentation of long-term development tendencies for the parts of agglomerations corresponding with spatial differentiation of commune categories.

This research has been conducted in the District of Halle which constitutes a major part of the Halle-Leipzig agglomeration. Possessing nearly all spatial types it is a good object of research in the framework of given themes.

1. THE RANK-SEQUENCE METHOD OF CATEGORIZATION OF COMMUNES

The rank-sequence method is based upon the quantification of differently selected qualitative categories through a rank number. The choice of factors (categories) for each commune is grounded upon the following premisses:

[1] The research could be feasible only on a basis of commune being the smallest unit covered by statistics. The division into communes and settlements is not identical; in some cases parts of individual settlements may be situated within administrative boundaries of communes.

— a settlement as place of peoples' habitance, of production and processing for extended reproduction of socialist economy is a multi-shaped whole;

— settlements are elements of a settlement system thus having certain tasks (functions) to fulfill, which later on leads to different economic ability of each spatial unit and contribute to the development potential of a commune;

— the actual economic potential of a settlement, formed by its most important structural units — infrastructure, structure of production, structure of population and structure of natural resources — co-acting complexively, eventually results from the substantial abilities of productive and cultural centres (Fig. 1).

The following elements have been selected as the crucial qualitative categories for the evaluation of the present economic abilities of a settlement and its development potential:

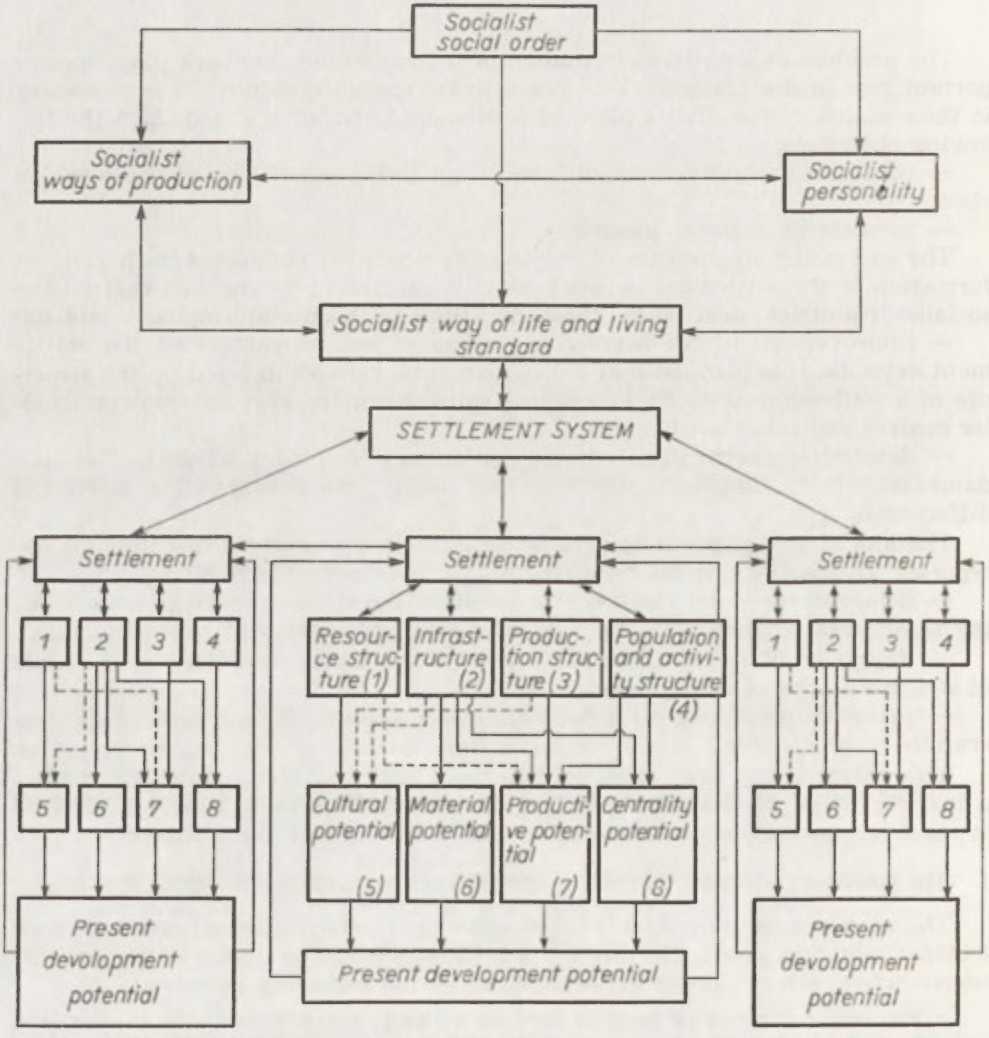

Fig. 1. Schematic presentation of social and geographical relations of a settlement within the settlement system

1. Transportation linkages between communes in 1970/1971;
2. Structure of housing in 1966/1967 and in 1965/1966;
3. Degree of provision of services in 1971;
4. Types of functions in 1971;
5. Potential labour force in 1964;
6. Industrial productivity in 1971.

1. TRANSPORTATION LINKAGES BETWEEN COMMUNES IN 1970/1971

Transportation linkages are a result of the density of the public means of transport (rail, bus lines) within a commune and its external ties. They also results from the frequency of service multiplied by the number of the corresponding lines of public transportation. In all highly developed industrial countries transportation is:

— condition of the increase of productivity and the growth of material production;

— an effect of material production through the movement of people and objects engaged in the process of production;

— a fundamental condition of the movement of people for recreational and educational purposes that is purposes related to the utilization of leisure time in the broad sense.

Therefore, the transportation may be treated as a measure of securing the socialist working and living conditions.

2. STRUCTURE OF HOUSING IN 1966/1967 AND IN 1965/1966

The structure of housing can be illustrated by the percentage of houses with gas, water and sevage lines. The structure of housing has to be considered a basis for estimating the economic potential of a settlement, because with ageing of houses their quality becomes unsatisfactory or just unsuitable to meet the requirements of extended reproduction in the socialist society. However, the technical equipment of dwellings is a precondition for the modern way of life.

3. DEGREE OF PROVISION OF SERVICES IN 1971

It is a coefficient resulting from the following indices:

— number of employees in the fields other than the material production;

— number of inhabitants;

— types of functions.

The value of the coefficient reflects the regional importance of a settlement. Generally, its regional importance grows with the increasing degree of service provision, recreational settlements being exception to this rule.

As regards an economic utlization of the existing resources, this coefficient should be considered in the process of the rational shaping of the whole settlement system.

4. TYPES OF FUCTION IN 1971

The classification of functions is related to the classification of industrial establishments for statistic purposes. They cover the following branches of the national economy:

— transport, communication;

— trade;

— other production branches;

— services;

— cultural and social establishments;
— state administration, social organizations.

The types of functions and the settlement size are in close connection, i.e., the greater the number of functions the better the conditions of meeting periodical or incidental needs of the settlement's inhabitants.

5. POTENTIAL LABOUR FORCE IN 1964

Potential labour force of a commune is a measure which allows to determine the economic potential of a settlement. Taking into consideration the "unhealthy" age structure of the population in GDR, this coefficient is presently an important element in estimating the development potential.

6. INDUSTRIAL PRODUCTIVITY IN 1971

The index of industrial productivity encompases the following elements:
— resident population;
— productive capacity of individual establishments;
— employment in industry.

This index differentiates the communes characterized by industrial production and evaluates them according to their share in the total of production.

Each of the given indices has been supplied with a rank number; the better quality given the higher value origining from the sum of settlements in an examined area. An equal quality is marked with the same rank number while the next lower levels are arranged respectively. With the lack of any of the given features within an order of numbers the quantification takes place only in respect to those communes in which that feature occurs. The total sum of rank number represents the existing economic potential of a commune with an exception of cultural potential.

Since the economic potential of a settlement is in close connection with its size and economic structure, it might be thus used to evaluate and outline the categories of communes.

On the basis of statistical frequency, the following five categories of communes have been developed in the case of the area under investigation:

Commune category	Development trends
1	Commune with population decrease
2	Stagnative communes with a conditional viability in long-term perspective
3	Stable communes, which as a rule will form elements of settlement complexes with development perspectives
4	Communes with conditional dynamics
5	Communes with gradually changing dynamics of population

The advantage of the rank-sequence method consists in the fact that different qualitative categories can be looked upon as a whole which gives an opportunity of evaluating the economic potential of a commune according to given capacity ranges, as well as of comparing them with each other. Subjective judgement is thus eliminated and a determination of basic factors by the way of factor analysis would more exactly define the resulting evaluation.

All communes can then, no matter what their spatial affiliation is, be treated, examined and devided into specific types of economic areas, the same method still being applicable.

A disadvantage of this method is that it refers to the existing level of quality which leads only to a relative evaluation of the development potential of a commune. The method is though applicable in the analysis of systematic commune categories of the different types of economic areas. It includes the following points:

— accounts for specific local features;

— provides a leading line as far as temporally and spatially co-ordinated development of investment policy is concerned;

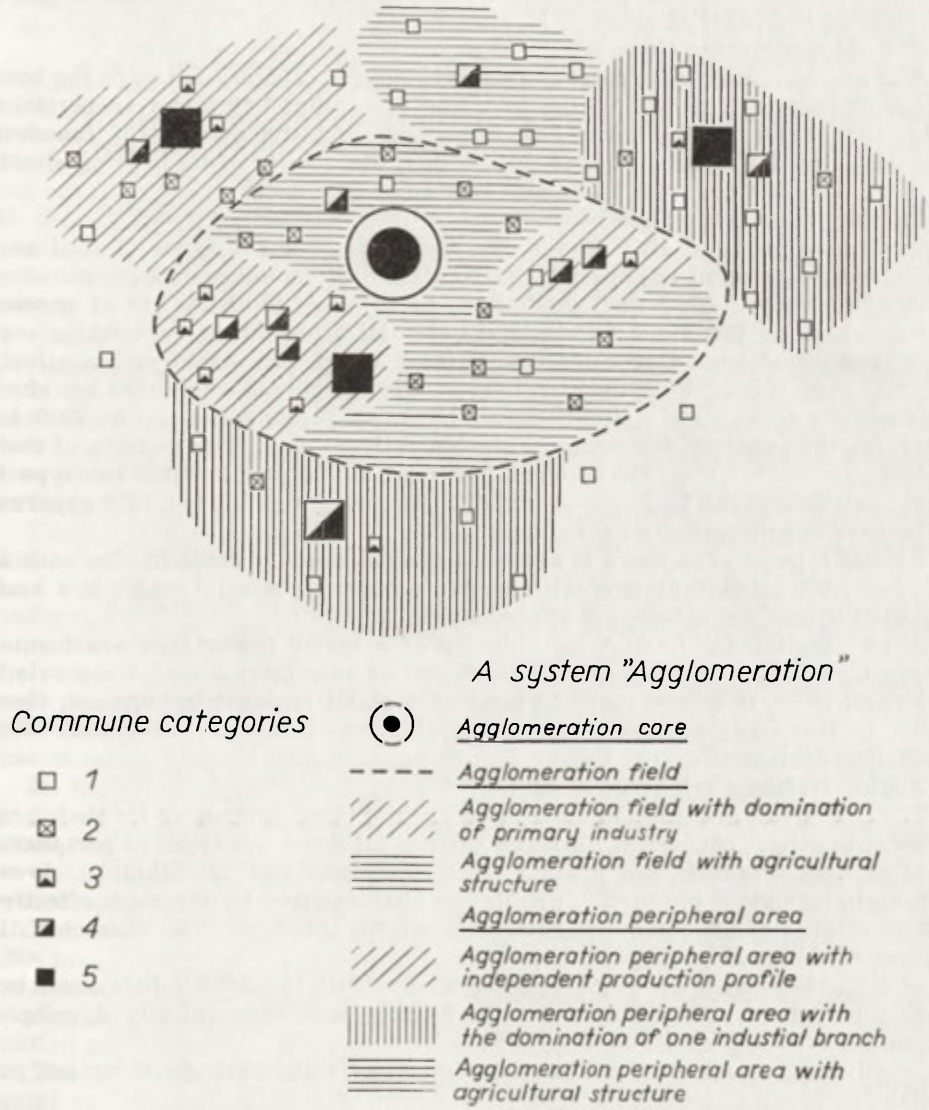

Fig. 2. Territorial differentiation of commune categories in the system "Agglomeration"

— marks the settlements in which short-term means of improvement of living standard are necessary.

2. SPATIAL DIFFERENTIATION OF COMMUNE CATEGORIES PRESENTED ON THE BASIS OF THE HALLE-LEIPZIG AGGLOMERATION (HALLE PART)

The Agglomeration

It is formed by a spatial cluster of communes with a relatively high development potential. It shows a specific differentiation of commune categories corresponding to the spatial structure of production. It shows a decline of productive development potential of communes from the core towards the peripheral area. This decline may be variable depending on different inter-regional relations of the parts of area.

The Agglomeration Core

The agglomeration core corresponds to commune category 5, i.e., to the communes of macro-structure. While, in terms of accessibility and transportation links, the degree of the provision of services and the number of functions it outstrips by far — all the other settlements, the quality of its housing should be improved. The agglomeration core is a large city itself.

The Agglomeration Field

L. Grundmann and H. Schmidt distinguished three sub-types of that area which are reflected in the spatial differentiation of commune categories.

Agglomeration fields with dominance of primary industry are at present characterized by the highest industrial potential after the agglomeration core in the examined area. Commune categories 3 and 4, i.e., stable and relatively dynamic ones, dominate in that territory, while category 3 communes are characterized by a peripheric situation and have, on the average, up to 3000 inhabitants, the category 4 communes are centrally situated. The number of their inhabitants varies as a rule between 3000 and 10,000 people. This sub-type is characteristic through its band- or ribbon structure which is especially apparent in the case of self-sufficient communes.

At this type of area there is always a central town of medium-size with about 20–50,000 inhabitants and with certain economic potential which is a basis including it into the category 5 of communes.

Agglomeration fields with no industry of a major importance are formed mainly by category 2 communes. Communes of categories 3 and 4 are relatively rare; if so, they are central places of a small regional importance. Generally, in the areas adjoining these central places there are communes with population decrease.

Agglomeration Peripheral Area

The peripheral areas of agglomeration are not homogeneous as far their economic structure is concerned. In Halle District all three sub-types of peripheral areas of agglomeration are present (L. Grundmann and H. Schmidt). Areas with an independent production profile are characterized by the most effective economic links of all commune categories within this type. The characteristic features of those areas are:

— a middle-size town (with population of about 20–50,000 inhabitants) belonging to category 5 surrounded by relatively well economically developed communes of category 3 and 4;

— a limited number of category 1 communes with weak development potential.

Peripheral areas without a dominant industrial branch are characterized by:

— more or less industrially developed central town of category 5 or 4 which at the same time is surrounded by communes with a relatively sizeable potential;

— a high number of small communes of category 1 (declining communes);

Peripheral areas with agricultural structure possess:

— a centre which is usually formed by a small town or a group of small towns of complementary functions; this centre corresponds to the development potential of the level 4;

— show an absolute predominance of category 1, i.e., declining communes.

3. TENDENCIES OF LONG-TERM DEVELOPMENT OF SUB-AREAS OF AGGLOMERATION BASED UPON THE SPATIAL DIFFERENTIATION OF COMMUNE CATEGORIES

Agglomeration Core

By long-term planning of economic development the advantages of the agglomeration core should be utilized, advantages resulting from its large city character, specially from the quality and quantity of infrastructure. Agglomeration cores have been reconstructed and adapted to modern socialist town model. At the same time their population constantly increases. Through their own specific development processes they influence the size and the level of development of other towns within the agglomeration system and partly — other surrounding areas.

Agglomeration Field

Agglomeration field dominated by primary industry.

Middle-size towns of this sub-type, depending on the direction of development represented by the agglomeration core, will be characterized by differentiated dynamics. The important impulses are the adoption of specialized functions being transferred from the core and the reinforcement of central functions performed for their own umlands.

Centrally located communes show the population increase only in exceptional cases, i.e., when a small town is planfully developed into a central place. As a rule, the structure and quality of housing should be improved through modernization and conservation and the transportation network expanded. High economic potential is the basis for a further industrial development specific for the particular area. The peripheral communes should be revaluated in a long-term perspective particularly from the point of view of qualitative changes in the housing and the improvement in transportation. Population increase in this case is not to be aimed at.

In the framework of the economic utilization of infrastructural equipment single central places may be characterized by a slow population increase. The measures aimed at long-term development of the stagnant communes should be oriented towards the expansion of transportation networks and the improvement of housing.

The inhabitants of communes in the state of stagnation should — in reasonable proportion — be moved up to the agglomeration core.

Agglomeration peripheral area

Agglomeration peripheral area with independent production profile and domination of one industrial branch.

The middle-size towns show diversified population trends while their material and productive potentials are in the process of intensive growth. The neighbouring communes of category 3 and 4 may become stagnant in terms of population numbers, although their functional relations with middle-size towns

should be strenghtened by the growth of traffic frequency and modernization and conservation of housing.

The inhabitants of communes in the state of stagnation should be partly located in their territorial centres, but mostly in the agglomeration core.

Other peripheral areas

Small towns being already at present central places and centres of area types will remain, as a rule, the territorial centres of major importance. They should nevertheless be characterized by a population dynamics in exceptional cases in the framework of a full economic utilization of newly constructed or expanded infrastructure. The inhabitants of stagnant communes should be mainly oriented towards the agglomeration core.

The settlement pattern within agglomerations will have a heterogeneous character. While the agglomeration cores are characterized by a dynamic growth of population and the transformations of city plans and architecture through the reconstruction of areas extending from the centre towards periphery and they stimulate the development of all other communes, the other major settlement centres possess lower dynamics. Only some of the middle-size towns, particularly those situated within the agglomeration field and its peripheral area and which have an independent production profile, can experience a higher population increase. In all other communes, with a developed level of population activity, the improvement in housing quality and transportation should be achieved.

Major means to increase the central place productive potential should be directed (in addition to agglomeration cores and middle-size towns) only to small urban centres.

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LOCAL ENERGY BALANCE IN URBAN AND INDUSTRIAL ENVIRONMENT

JANUSZ PASZYŃSKI

INTRODUCTION

During the last several years living conditions of a large part of our population have undergone many changes. This was caused by rapid growth of industrialization, which in turn induced the migration of rural population to towns and industrial settlements, in other words urbanization.

Such rapid development of industry and the creation of new urban centers transformed the physical and biological environment in many areas. Those transformations were not restricted only to regions where the actual urban centers and industrial plants were located but in many cases they spread to neighbouring areas.

Those changes and transformations — often quite unintended — are very diverse and it is therefore difficult to generalize them.

Nevertheless there exists a number of common features, occurring everywhere where we have to do with the processes of industrialization and urbanization, as well as many other common regularities governing the transformations of environment which are connected with these processes.

Those rules allow of a very general definition of urban and industrial environments.

METHOD OF RESEARCH ON THE FEATURES OF URBAN AND INDUSTRIAL ENVIRONMENTS

Urbanization and industrialization are usually mutually inter-connected. Nevertheless the two phenomena should be differentiated. A closer analysis of urbanization and industrialization — in the ecological sense — fully justifies the above statement. The fact of their overlapping hampers exact interpretation in many cases, but remains irrelevant from the methodical point of view, since both phenomena may be treated in isolation. In Poland there are many towns with no industry on one hand and the other numerous industrial plants situated far from urban centers.

Each type of geographic environment is shaped as a consequence of basic physico-geographic processes of energy exchange and transfer of matter occurring in the atmosphere, hydrosphere, litosphere and biosphere. All those processes take place in accordance with the fundamental physical law concerning the conservation of energy and of matter. Quantitively they may be presented in the form of a number of equations: equation of heat balance, equation of wa-

ter balance, equation of denudation balance and the equation of organic substance balance.

A conscious transformation of environmental conditions may be obtained by modifying the structure of the balance in question. By the term structure we mean the share of particular components and their mutual relations to one another. That is why the research on process occurring in geographic environment is so important.

It is to be remembered, according to the physical laws concerning the conservation of energy and of matter, that a change in the value of one of the balance components causes also a change in other terms.

Apart from that all the physico-geographic processes mentioned are strictly connected with one another.

That is why it is necessary to define the features of processes of the energy exchange and of the matter circulation, occurring in urbanized and industrialized regions as well as to state how they differ from the same processes taking place in regions where the action of man is negligible.

ENERGY EXCHANGE PROCESS IN URBAN AND INDUSTRIAL ENVIRONMENTS

The process of energy exchange permanently takes place in nature. The most significant role in the forming of the geographic environment is the energy exchange on the interface earth-atmosphere. Quantitively this process may be expressed in the form of equation of energy balance on the active surface, in this case equivalent to interface earth-atmosphere. In its simplest form the equation is as follows:

$$R + B + P + E = O$$

where:

R — Radiative heat transfer;
B — Conductive heat transfer;
P — Turbulent transfer of sensible heat;
E — Turbulent transfer of latent heat of evaporation and condensation of water.

Other forms of heat exchange, as for example the transfer of heat through precipitations or the use of energy in photosynthetic processes, have very small numerical values in comparison with the four main components, and may therefore be left out.

Each of those components may acquire a positive or negative value. The heat flux is regarded as positive when it is directed towards the interface, upwards or downwards. The heat flux is regarded as negative when it is directed away from the interface either upwards or downwards.

It should be added that the values of particular components are commonly expressed in units of heat per unit of surface and time (e.g. cal. $cm^{-2} \cdot min^{-1}$). They may be determined either through direct measurements or through calculations based on various types of empirical formulae expressing the ralation between the components of the heat balance and different climatological factors quite easy to be measured or observed. For example: the amount of heat used for evaporation may be calculated empirically knowing the air temperature, the air humidity and the wind velocity.

The previously mentioned heat balance equation refers to natural conditions or those only slightly modified by human activity. However in urban and industrial areas the rate of each term is subject to far-reaching changes, leading to considerable modifications in the structure of heat balance. Apart from that —

as we shall see — other components may appear in the heat balance of those regions, and therefore change the present form of its equation.

The mechanism of those changes is based on the influence exerted by a number of different factors, and namely;

(a) modified physical properties of the substratum;
(b) modified geometry of the interface;
(c) additional sources of heat reaching the interface earth-atmosphere;
(d) atmospheric pollution.

All those factors exert a particular influence in both urban and industrial environments, although not to the same degree. Thus the heat balance of urban areas is shaped by the first two factors, i.e., physical properties of the substratum and geometry of the interface. As far as industrial regions are concerned additional heat from artificial sources and atmospheric pollution are the two dominant features.

INFLUENCE OF PHYSICAL PROPERTIES OF THE EARTH SURFACE

Urban areas differ from their environment due to the type of substance forming the substratum of the atmosphere. Instead of the cultivated fields, orchards, pastures, meadows and forests which are predominant in the rural environment, we have various construction materials like bricks, stones and tiles covering walls and roofs of houses on the one hand and asphalt or pavement covering the surface of streets and squares on the other. Due to the lack of vegetation evapotranspiration is reduced and so is the amount of heat consumed by this process. Therefore the component E, constituting in our climatic conditions about 50% to 80% of the expenditure side of heat balance, is considerably decreased in urbanized regions. This also arises from the increased rate of runoff accelerated by the canalization system. In Warsaw, for example, all the vegetation in the center of the city constitute about 3% of the area. However, it must be remembered that the evapotranspiration is increased from green areas surrounded by built up areas, and this increase is due to the advection causing the horizontal transfer of dryer air from built up areas.

A relatively high heat conductivity of construction materials as well as their higher heat capacity, in comparison with rural areas, facilitates the conduction of heat between interface and substratum, thus modifying the component B in the equation for the energy balance. Therefore the relative value of this component is bigger in cities than in surrounding regions.

The thermo-physical properties of the substratum of urban areas mitigate against a rapid cooling off of the interface and of the adjacent air layer during clear nights as well as against a rapid loss of heat accumulated in the substratum during the day. This phanomenon is especially acute due to the lack of vegetation, constituting an isolating layer in rural areas, because of its bad heat conductivity hampering the heat transfer from the substratum to the interface during periods of intensive outgoing thermal radiation.

INFLUENCE OF GEOMETRY OF THE INTERFACE EARTH-ATMOSPHERE

Buildings and other forms of construction to various heights in urban areas involve the augmentation of the geometrical irregularity of the interface earth-atmosphere. The degree of this irregularity may be expressed quantitatively by the so-called roughness parametr (z_o). Numerically this parameter expresses the height above the ground at which the wind velocity falls to zero

under neutral stratification. For a city, treated as a whole, values of this parameter are several times higher than for non urban areas. In Łódź, for example, z_o is about 5 m while it reaches about 20 cm for crops, and about 1 cm only for short grass (Paszyński, *et al.*, 1971). Together with the increase of the roughness of the interface, the turbulent transfer of air of dynamic origin in the atmospheric surface layer also increases. This is to be considered as a rather positive phenomenon because it facilitates the mixing of air over the city, thus causing natural clearing of the atmosphere from pollutants over urban and industrial areas. An increase in turbulent transfer of thermal origin also contributes to this, due to different heating of shaded surfaces and those exposed to the sun. Therefore increased roughness of the interface earth-atmosphere must be regarded as a positive phenomenon in connection with better possibilities of exchange of the air over the city.

We may assume that as far as the possibilities of self-cleaning of the atmosphere are concerned, the optimal structure of urban areas seems to be one where relatively large built up areas are located in the neighbourhood of green surfaces. The dispersion of vegetation within a city seems to give worse effects. This problem, however, requires more detailed comparative studies in relation to the cities of different structure.

INFLUENCE OF ADDITIONAL SOURCES OF HEAT

In all large urban agglomerations, and especially in industrial centres, significant amounts of coal and of other fuels: solid, liquid and gaseous, are used. In Poland the average annual fuel consumption gives about $600 \cdot 10^3$ Tcal of heat (Kraujalis, 1971). About 44% of this amount is used for industrial purposes, and about 14% is used for transportation purposes. The remaining 42% is used for domestic purposes, and mainly for heating buildings. In some regions and during some periods, especially in winter, the amount of heat obtained from such sources is already comparable with the incoming solar radiation.

In urban and industrial regions we thus have to deal with an additional component of the heat balance. The equation for the heat balance in such con ditions will be as follows:

$$R + S + B + P + E = O$$

where S is the heat flux generated by man's activity.

Poland's average annual value of term S is about 200 cal.cm^{-2}. In comparison with the heat obtained from solar radiation this amount is quite insignificant since it is equal to only 0,25% of global solar radiation. However, in some industrial cities of Upper Silesia this ratio is over 10%, and in some cases is as high as 20%, as in Bytom, Chorzów, Częstochowa or Wałbrzych. For Warsaw this ratio is equal to about 5% [1]. In winter this ratio is even bigger, due to larger fuel consumption. However, there are no adequate data concerning the seasonal variations of S.

The ever increasing significance of the component S in the heat balance of interface earth — atmosphere should be noted. In Poland its average annual growth is about 6%.

[1] Cf. M. W. Kraujalis, Artificial heat over the territory of Poland, *Geographia Polonica* 21, 1972, Fig. 5.

INFLUENCE OF AIR POLLUTION

Substantial air pollution in industrial and urban regions involves not only important modifications in the composition of the atmosphere, but it also influences the heat balance and its structure.

This influence may be observed through the attenuation of incoming direct solar radiation, reaching the earth surface. This phenomenon is very pronounced in the Upper Silesian Industrial District and in other large urban or industrial agglomerations like Warsaw or Cracow. It is presented on the map illustrating the transparency of the atmosphere in the Upper Silesian Industrial District [2]. This transparency is expressed by the turbidity factor computed for the short-wave spectral region (Kluge, 1969). The attenuation of direct solar radiation is partly compensated by its increased scattering due to pollutants of industrial origin suspended in the atmosphere. On the whole, however, the global solar radiation, i.e., the sum of the direct and diffuse radiation, in areas with heavy atmospheric pollution is considerably limited in comparison to that in neighbouring areas. On the basis of climatological data this decrease in the Upper Silesian Industrial District is estimated at 12% on the annual scale (Paszyński, 1972). This is presented on the map illustrating the geographical distribution of mean annual global radiation in Poland. One can clearly distinguish an "island" of relatively low values, which corresponds to the Upper Silesian Industrial District.[3]

The flux of incoming long-wave radiation of an atmosphere containing a large number of suspended particles may be more intensive than that of clean atmosphere. We may therefore assume that the outgoing long-wave radiation from the earth surface (so-called effective long-wave radiation) is weakened due to the air pollution. This modification of radiative transfer similar to the glasshouse effect, may be caused by all types of suspended particles: solid, liquid or gaseous. This effect is in a certain degree similar to the influence that cloudiness exerts on the attenuation of outgoing long-wave radiation, and it would induce a certain increase of air temperature in the atmospheric surface layer. However, exact measurements of long-wave radiation are still to be made before this hypothesis is fully acknowledged.

The pollution deposited on the earth's surface diminishes its reflectivity for the short-wave radiation, i.e., albedo of the earth surface. This phenomenon is of special climatic significance during winter. Since the snow cover is less durable in urban and industrial areas, due to decreased albedo, the absorption of solar radiation is greater. It is worth to mention that the albedo of freshly fallen snow is over 65%, while the albedo of dirty snow is often far below 25% (Kozlowska-Szczęsna, 1973).

The overall effect of atmospheric pollution is to exert an important influence on the component R of the heat balance, that is on the radiative heat exchange. Therefore the values of this component in urban and industrial areas decrease during the day-time (mainly in the summer) and increase during the night-time (mainly in the winter) as compared with surrounding areas.

CONCLUSIONS

The influence exerted on the heat balance of the earth-atmosphere interface by all factors mentioned causes distinct climatic differences between urban or

[2] Cf. J. Paszyński, L'influence des conditions climatiques sur le developpement des villes, *Geographia Polonica* 12, 1967, Fig. 5 (after M. Kluge).

[3] Cf. J. Paszyński, Studies on the heat balance and on evaporation, *Geographia Polonica* 22, 1972, Fig. 2.

industrial regions and their surroundings. This influence results in different thermal conditions for those regions.

These phenomena induce the increase of air temperature in big cities bringing the formation of "heat islands". The increase of air temperature is caused by a change of numerical values of all of the components of heat balance. This must be remembered when analysing the problems connected with the possibilities of a conscious transformation of the existing climatic conditions, and especially of thermal conditions, by introducing changes and modifications in regard to the interface earth-atmosphere.

The differences of temperature between the city and its surroundings especially high during frosty winters involve increased cloudiness and promote local systems of winds. The wind velocity in the atmospheric surface layer is generally smaller in cities. So is the air humidity.

It is to be remembered that climatic conditions depend on a great many factors; that is why it is often difficult to separate the influence exerted by one particular factor, as orography or soils, since they overlap in many cases.

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SOME NATURAL ENVIRONMENTAL CHANGES WITHIN THE HALLE-LEIPZIG AGGLOMERATION AND THEIR INTERPRETATION

KONRAD BILLWITZ

1. INTRODUCTION

The trend observed today towards a steadily growing spatial concentration of industrial production favours the agglomeration of production and population. This necessitates an increased utilization of both economic and natural resources within such areas.

The resulting "exchange" with nature (*geotechnischer Metabolismus*, acc. to E. Neef, 1967, p. 31) occurs in our era of scientific-and-technological revolution on an enormous scale, whereas the individual geo-factors or elements of the landscape (i.e., water, soil, air, area, woods, minerals) assume the character of resources. They are being partially displaced in the process from their natural structure, processed, re-shaped and altered according to the purpose of their utilization. In course of the above process, man not only removes material or energy out of the natural milieu, but also returns such materials and energy. The natural milieu is, however, frequently, not in the position to absorb such recovered materials and energy, or to accumulate them safely. This requires basically new economic-expenditure.

The above scope of man–environment problems, or in other words questions arising within the system of the socialist land management are in my opinion too heterogeneous for geography to deal with them. They are rather involved in the ever more intense utilization of territory, the phenomena and processes in space, the changed material and energy management, i.e. the geo-ecology of intensely utilized geo-systems within the agglomerations. Since only individual preliminary geographical studies are available on the subject, we shall point in the further course of this paper merely to particularly intensely claimed natural resources which in addition to the complex problems will require in future a greater attention.

2. AIR AS A RESOURCE

The terrestrial atmosphere is to an ever increasing degree used by man for the disposal of solid, gaseous and liquid waste. Thus, an occurrence is noted frequently, particularly within the agglomerations and over the centres of certain large cities, of concentrations of harmful pollutants which the atmosphere can no longer dilute and to remove effectively. Out of substances known to date, and emitted by industry, by household facilities and by vehicles, and which affect men, animals and plants in an irritating or harmful way, we may

quote here: soot, ashes, SO_2, CO, H_2S, NH_4, NO_2, fluor compositions, phenols, chlorophenols and other unburnt hydrocarbons, lead compositions and active herbicides. Many of the above substances are of a poisonous effect. While acting upon the vegetation and soil, they upset the biological balance and thus the entire natural environment.

One of the effects of such SO_2-emissions is the presence, to the East and North-east of the Halle–Leipzig–Dessau agglomeration, in the Dübener Heide forest, of some 60,000 ha of damaged pine trees. The damages range from disturbances within the assimilation organs, over damages — which can be noted on the decrease of yield — chronic up to the total necrosis of plants (H. G. Dassler, 1969), whereas the so called "smoke devastation areas" within sloping areas are most susceptible to erosion. Damages are also occurring in crops though they are difficult to estimate because of annual crop rotation. Notable are the fodder losses as concerns pasture plants, due to selective assimilation. In Fig. 1 are the most essential dust and SO_2-emissions given, as related to a certain part of the Halle–Leipzig agglomeration. An attempt has been made at the same time, to plot lines representing equal monthly dust sedimentation values with the use of the few sedimentation dust measuring points available. The picture in the chart shows a particularly heavy load in the Geisel valley, in the vicinity of the Leuna- and Buna Works and in the municipal area of Halle. Daily SO_2-emissions amount within the entire area to nearly 1700 tons, those of dust — to nearly 800 tons. Local emissions of 70–270 g/sq·m·30 d are furthermore noted within the direct vicinity of briquette factories, power plants and other large-scale dust producers. Basic load on the atmosphere due to dust and particularly as concerns SO_2 is averaging generally speaking in excess of values permissible from the viewpoint of human health. Some of the changes visible in the vegetation are effective only above the soil surface. According to the chemical properties of emissions which penetrate also into the soil, the continuous soil-making processes are being diverted into specific directions. Chemical and physical changes are noted as concerns the acidity relations, mineral matter balance, the formation of humus, the density of soil and its structure. The soil is, of course, capable of rejecting many of the above reactions. However, with the action of such substances being continued for decades, also changes in the pedosphere are becoming inevitable.

The effects of emissions affect men and animals in the same way, whereas the influence thereof upon the health conditions of the man cannot be evaluated to date. The medical authorities note for the time being a considerable peak of respiratory tract diseases within the agglomerations.

Apart from changes in the natural environment as quoted above, due to air pollution, one should by no means underestimate the direct influence of the latter upon certain meteorological phenomena (reduction of 20–50% as concerns radiation emission, air temperature increase, facilitation of condensation phenomena, and thus of occurrence of fog, and many others). This causes after-effects within the entire nature which, however, cannot be evaluated to their full extent.

Although one must resort above all to technological safety measures in order to prevent harmful effects of emissions, we can already note adaptation processes to the air pollution within agglomerations advancing in the nature and in the society which are of a distinct influence upon the whole of the territorial structure:

— natural selection and planting of "smoke-resistant" tree species cause changes in the forest stand;

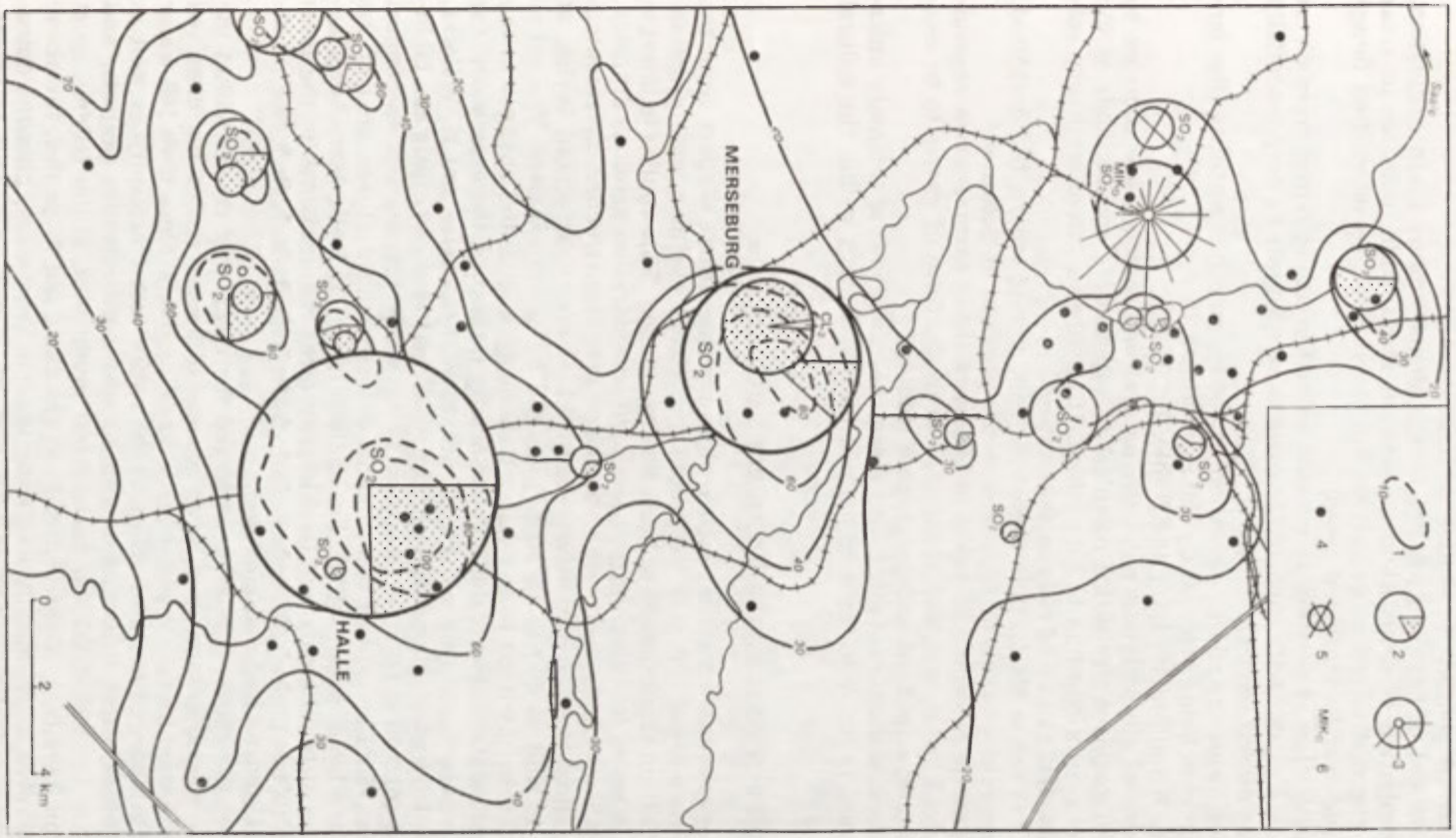


Fig. 1. Halle–Merseburg. Emission of pollutants and dust sedimentation

1 — presumed lines of equal dust sedimentation (g/sq m·30 d) average for 1967–1970; 2 — dust emissions 1970; 3 — pollution compass rose for SO_2 (1969/1970); 4 — sedimentation measuring post; 5 — 1967 or 1970 value — out of operation today; 6 — MIK_D = maximum permissible emission concentration (permanent load); according to Hammje-Schiller (1971), Hammje-Rauh-Schiller (1972) and to unpublished emission data of the Bezirkshygiene-Institut, Halle. Tabulated and plotted by K. Billwitz (1972)

— small wood planting to shelter settlements;
— replacement of beet and pasture forage plantations by grain cultivation;
— differentiation of crops (field grasses, oil seeds, frain, potatoes in areas most exposed to smoke action; on the other hand, an intensified forage growing over less inflicted areas);
— intensification of rotation as regards animal breeding (apart from direct animal losses, e.g., the milk capacity of cows is also known to drop essentially when feeding dusted fodder);
— shifting from the silo preservation of fodder to other methods (the fermentation process being affected by lime containing dust);
(according to Krummsdorf, 1970, and Rühle, 1972).

The effects of air pollution upon the natural environment are complex to a degree that requires the entire potential of experiences and methods of the branch of science in question to solve them. It is only an interdisciplinary collective action that can be of help in this respect.

As concerns the methods, those following can, among others, be considered:
— a measurement analysis approach to the problem of pollution;
— a diagnostic recording of losses in excess of those normal, extra expenditure, increment losses, etc., and plotting them in the form of charts to be evaluated (including a medical-and-geographic study);
— long-term stationary studies concerning sub-complexes of intensely utilized geo-systems, in order to form an opinion on the changes within the natural balance.

3. WATER SUPPLY AND WATER RESOURCES UTILIZATION

Of all the elements of a landscape within agglomerations — apart from the densely built-up areas — it was the creeks and rivers together with processes progressing within them that have been mostly effected. This applies to changes caused due to water installations (projects with consideration given to drainage, water regulation, supply from other drainage area, construction of retention dams, navigation locks, hydro power plants, harbour construction, laying of ponds, etc.) as well as due to an acute pollution by sewage waters. The entire scope of problems involved in the water technology and in the changes in the whole environmental balance, shall be but briefly treated on the example of the so-called "Leipzig water system" (Fig. 2; acc. to W. Schwartze and K. Walotka, 1964). The entire hydrologic relations of the municipal area of Leipzig can be influenced and controlled by man according to the water balance and economical considerations. Similar control measures as concerns the drainage area of the Saale river are being taken within the agglomeration of Halle–Merseburg, according to the social economy and land improvement requirements, in the form of reservoirs in the upper river course (low-water retention, high water retention salt load control, and many others).

Apart from the above, it must be observed the rivers and creeks within the Halle–Leipzig agglomeration area have become transport routes for dissolved and finely dispersed inorganic and organic waste products. More than 100 water contained substances of harmful effect to the entire water economy as well as to the individual water installations and to water distribution projects, and furthermore to the industrial and agricultural production, to the fishing, sport and recreation have been noted. Apart from chlorides and sulphates, the above substances involve biochemically oxidating organic substances, phenols, eutrophic substances, soda lye, sulphuric acid, and other materials. This is accompanied at the same time by a "heating-up" of rivers by an afflux of cooling

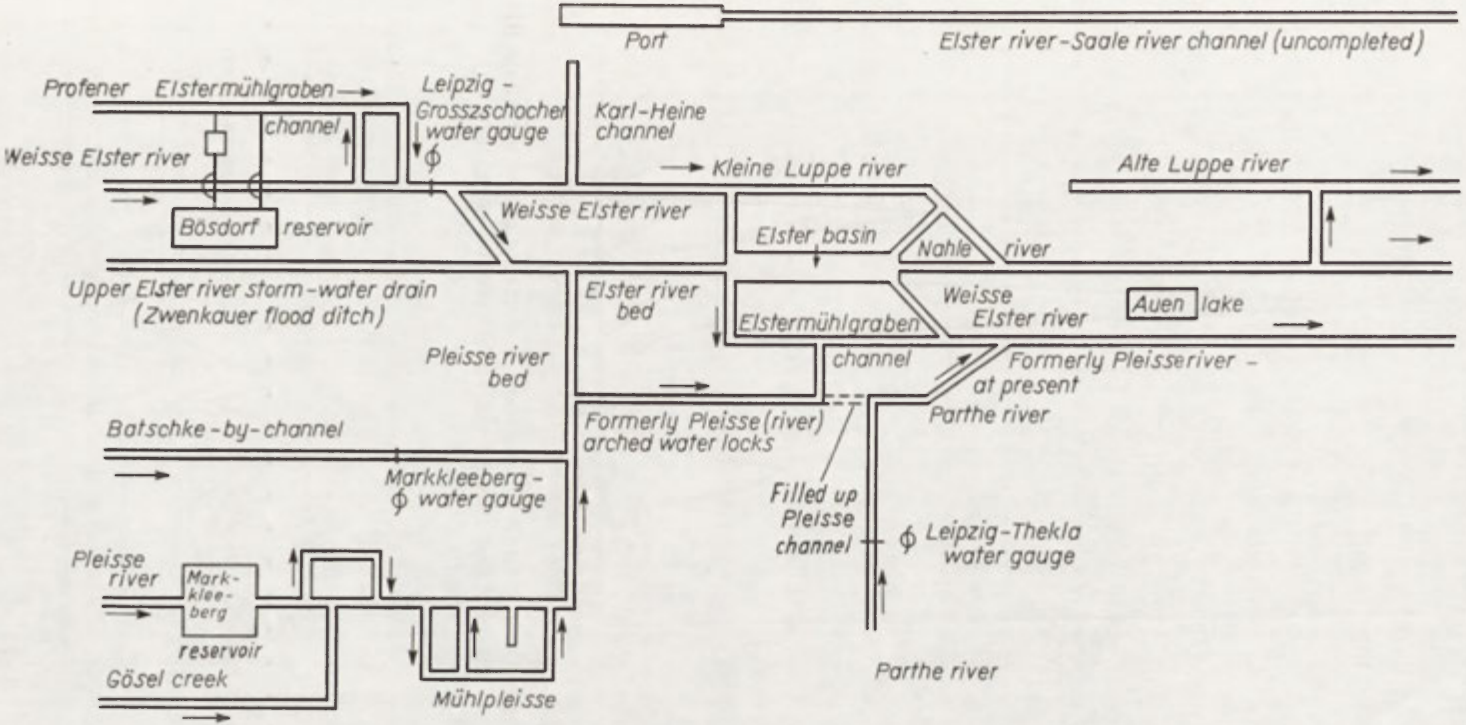


Fig. 2. Water supply system Leipzig. A diagram

According to the records of the *Wasserwirtschaftsdirektion* (Water System Management) Saale-Weisse Elster River, Halle

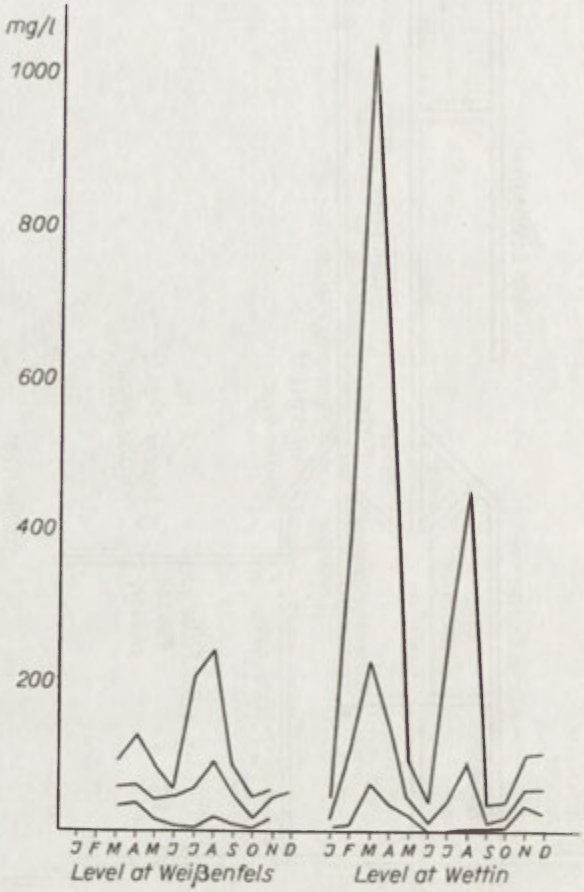


Fig. 3a. The rate of drifting and sedimentary materials flow in the Saale River while entering and leaving the agglomeration core, 1970

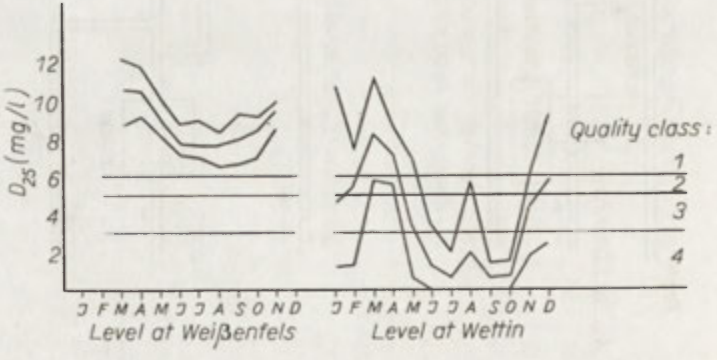


Fig. 3b. Saale River oxygen reduction rate while entering and leaving the agglomeration core, 1970

water which when combined with pollution adds up to cause major changes within the entire system of water resources. Flora and fauna are diminishing; the biological self-purification capacity is interfered with or eliminated; a widespread of morbific agents is observed; the occurrence of ground water and bank filtration is hampered; the quality of ground water is deteriorated; shrubs within the bank reach are dying off, silt builds up.

The Saale river enters the agglomeration of Halle-Merseburg near the locality of Bad Dürrenberg carrying water of the quality class 2 as measured on the waste load. The Saale river waters are soon becoming a transport route for solid and liquid waste products so that their quality class drops rapidly to 4. The individual plants are to a varying degree responsible for the contamination load according to equivalent *per capita* figures [1] (see Table 1).

TABLE 1

Plant	EWG (*per capita* equivalent) 1970
Chemische Werke Buna	2,084,650
Leuna-Werke "Walter Ulbricht"	1,173,500
Zellstoff-und-Papierfabrik Merseburg	1,097,000
Gaswerk Halle (uncertain, out of operation since 1972)	405,000
Trockenwerk Benkendorf (period of production)	3,250
Mineralölwerk Lützkendorf	11,714
Brauhaus Halle (brewery)	8,200
Kraftwerk Halle (power plant)	117
Sewage treatment plants of communes	251,778
	5,035,209

The actual population figure of the region as outlined above amounts to 0.5 million inhabitants.

This enormous pollution load still augmented by the admission of a further 1.4 million EGW (*per capita* equivalent figure) from the Leipzig region via the Weisse Elster river, triggers at the same time many further processes of serious consequences for biological life within the river, for the utilization thereof as an inland waterway, as a recreational water route, and many other purposes.

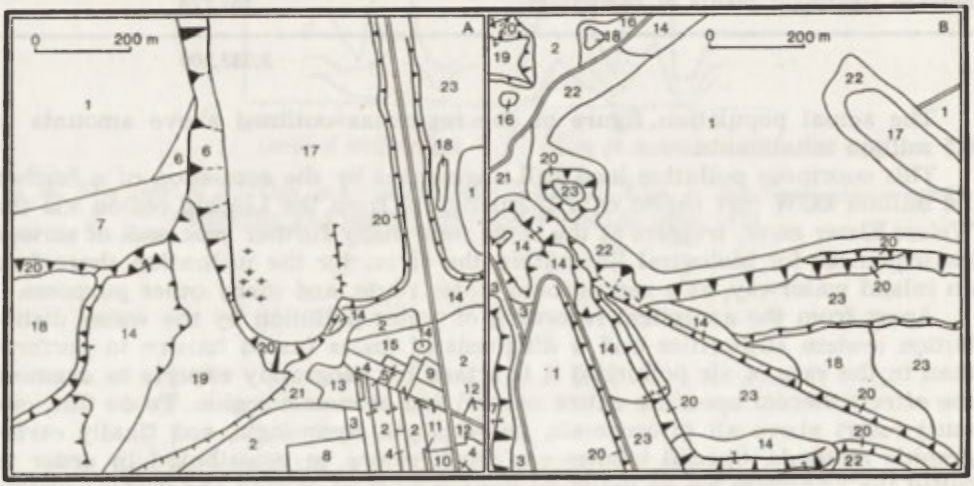
Apart from the analytical recording of water pollution by the water distribution system authorities and a diagnosis of losses (much harder to perform than in the case of air pollution) it is a task for geography experts to examine the effects thereof upon the entire natural and economic region. To do this, one must resort above all to economic, geo-ecologic, hydrologic, and finally cartographic methods. Special studies can furthermore be contributed in order to fulfill the principles for an optimum development of ground and surface waters and for the ensuring of drainage with a consideration given to the natural and social factors.

[1] EGW = *per capita* equivalent figure = BSB_5 of a sewage quantity / BSB_5 of an average contribution of waste water per capita (appr. 50 g O_2 consumption during a 5-day period)

BSB_5 = O_2 content reduction during a 5-day period of biochemical oxygen consumption: a measure with respect to an organic substance which can be reduced due to the effect of bacteria action.

4. LAND UTILIZATION

Since all the spatial processes — including, of course, those of the agglomeration of industry and population — are in this or another way area oriented, they simultaneously find their reflection in the land utilization within the regions in question. It is particularly within the agglomerations that a certain "land shortage" occurs more frequently, this essentially resulting from land being looked upon as a resource. In this respect, it is not the agricultural land utilization that is meant, but in a comprehensive sense the utilization of land surface (*zemlepol'zovanije*, land use, *l'utilisation des terres*). This is to be understood as the utilization as reflected upon the earth surface and having its impact upon it. This can be effected at varying levels (storeys) (= *Nutzungsstockwerke* — utilization storeys according to K.-H. Krause and H. Richter, 1971). A potassium salt mine situated 1000 m underground has thus no, or quite specific influence upon the land use while a brown coal strip mine at a depth of 25–40 m is of an aggravating impact upon the land utilization due to pits and hollows left over after its operation. Thus, the extraction of mineral resources and land utilization are closely connected with one another. Consequently a grasping of land use and of the exploitation of resources are essentially helpful in tracing the impact upon the natural landscape exerted by man and his technology. Surveying the land use will thus help to record the essential changes in the environment. Let us illustrate the above with an example taken from the area of the city of Halle: Records of an inventory of the land use within the Halle and Halle–Neustadt region on 1:2000 to 1:10,000 scale (sectors: Figs. 4a, 4b) and those of the resource extraction (brown coal, sand, gravel etc.,



Rig. 4A. and 4B. Post-strip mine cavity Bruckdorf–Nord (distance from Thälmann-Platz: 3000 m)

Present major utilization: water sport and swimming pool (23.6 ha); secondary utilization: agriculture (23.2 ha) and refuse dump (16.4 ha). Interference with landscape balance: Excavation of Pleistocene sands and gravels until 1969 as well as of upper Eocene and middle Oligocene brown coal by strip mining from 1902 until 1939 (underground mining 1913); agricultural re-cultivation of the inner dump (upper left) accomplished; partial reafforesting of the stopes; refuse and sewage dumping into a left-over water filled cavity — hence a strong pollution also of ground water: adjustable drinking water supply in two installations (3000 and 800 m distance); with soil dewatering stopped, a rapid filling has occurred of the left-over cavity up to the depth of 7.5 m below the ground level; refuse dumping has caused a violent odour and dust vexation to the township of Kanena. Slopes unstable heretofore

Fig. 4b. Post-strip mine cavity Bruckdorf-Süd (Distance from Thälmann-Platz: 4000 m)

Present major utilization: agriculture (40.9 ha); secondary utilization: refuse dump (14.1 ha). Interference with landscape balance: excavation of upper Eocene and middle Oligocene brown coal by underground (1896 until 1924) and strip mining (until 1966); agricultural re-cultivation of inner dump basically accomplished — agricultural amelioration was not required: today cultivation on sand-moraine-rock waste and on Tertiary sand dust-coal dust-dump rock; a strong tendency of such surfaces towards retaining moisture, partially an occurrence of water sheets over the dump; drainage facilities still intact — therefore ground water still inside the left-over cavity; large areas claimed by dumps basically of industrial wastes; reafforesting of the high heap (lower left) with foliaceous trees; slopes unstable

Key of symbols to the land use map 1:10,000

Agricultural use

1 — Arable land (re-cultivated mixed dump soil); 2 — Arable land (non-cultivated soil, partially post-mining area); 3 — Pastures

Horticulture and fruit growing

4 — Small garden lots and allotments; 5 — Gardening land (partially decaying)

Forest

6 — Foliaceous wood of young growth (over dumps, heaps and slopes); 7 — Foliaceous wood of old growth (over dumps, heaps and slopes)

Other utilization types

8 — Sport facilities; 9 — Storage yards; 10 — New building grounds with surroundings; 11 — Garages; 12 — Cottages with front and rear gardens; 13 — Industry, handicraft; 14 — Refuse, ash and sewage dumps;

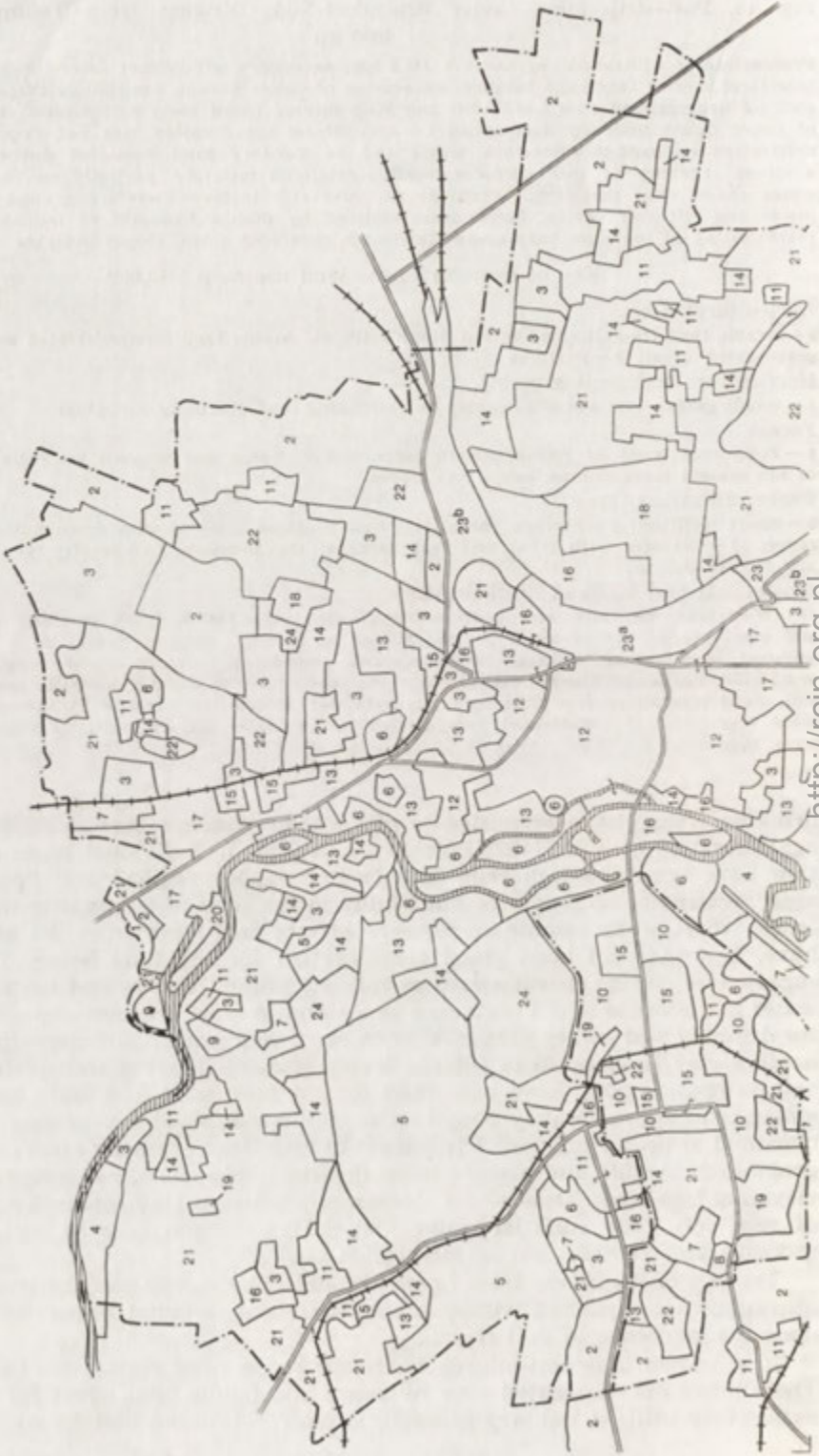
Wastelands and lands of limited utility

15 — Wasteland, partially over post-mining grounds; 16 — Fallow land, partially with fertile soil overlayer on top of 15; 17 — Water area for fishing, bathing, sport; 18 — Water area polluted with refuse, sewage; 19 — Wasteland, post-dump grounds, weed vegetation; 20 — Wasteland, heaps and dumps, basically not overgrown; 21 — Wasteland, basically non-cultivated soil, weed vegetation; 22 — Wasteland, basically flat; mixed dump soil of Pleistocene material, weed vegetation; 23 — Wasteland, non-levelled gap or crater ground, partially overgrown with scant shrubs

drinking water) have permitted to plot a map of major uses (1:50,000) for the agglomeration core of Halle/Halle-Neustadt (Fig. 5). Individual types of utilization have been fixed therein, like "water supply region" and "post-mining area", which are no longer or not wholly in the state of a complete natural balance, whereas the remote or adjacent effects projecting from the above sites have, however, not been given consideration for the time being. The water supply area can be characterized as follows: ground waters and bank filtration water in Holocene and Pleistocene sands and gravels are obtained and treated for drinking and utility purposes. Such sands and gravels are deposited underneath a clay layer of 40 to 100 cm deep. Plentiful filtering wells, lifting pipes and infiltration pools have been built for gaining water. The daily water input amounts to approximately 35,000 cu.m. The agricultural use of this land area classified as protection zone I is subject to restrictions (among others fertilizing prohibited). Arable and pasture lands dominate. Narrow shrub strips mark the elevating pipe-lines. Dead water sleeves and left-over clay pits make reservoirs of relatively pure surficial water that serves the purposes of enriching the ground water reserves *via* an infiltration pool.

The size of the above areas (approximately 18.5 sq.km) and the technological operations accomplished within it emphasize the essential impact of the man upon the landscape of that region.

It is known that post-mining landscape strips need restoration (see Fig. 4). Those latter are dominated over by waste and fallow land, areas for dumping, extensively utilized military grounds, extensive farming and forest areas, etc.



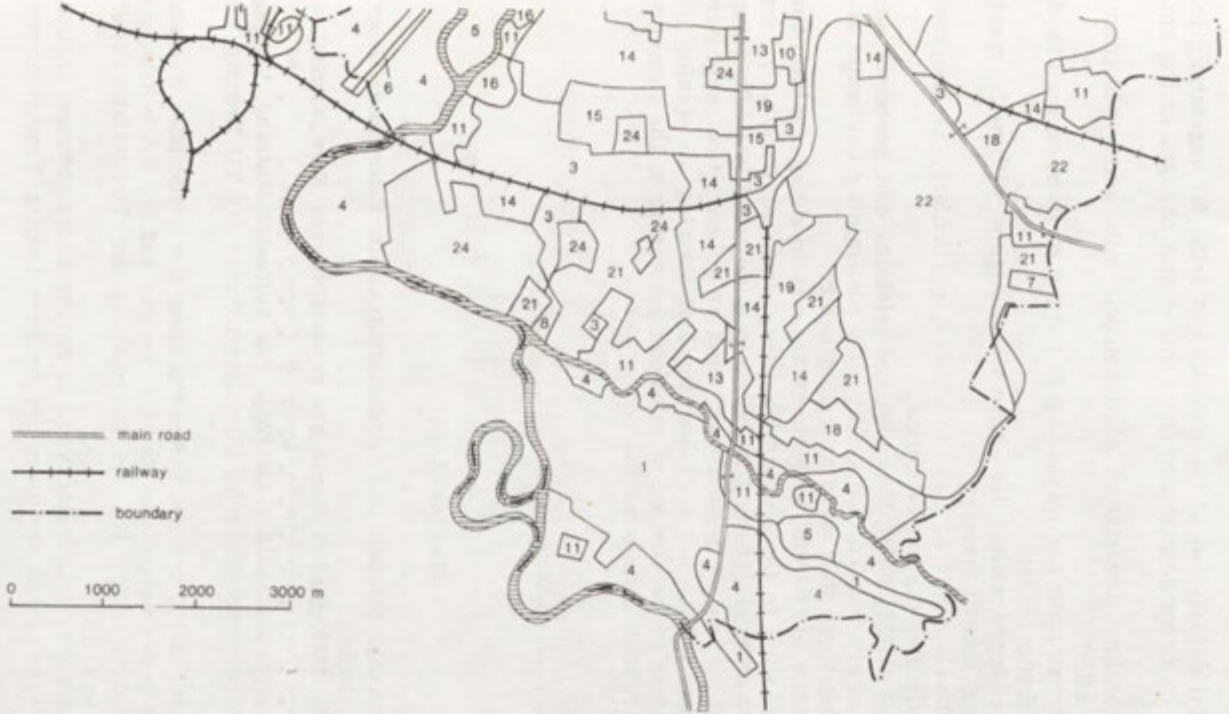


Fig. 5. Principal types of utlization: Halle/Halle-Neustadt
By: K. Billwitz and R. Janckel. Drafting: E. Mühlberg

1 — Water supply area; 2 — Arable land (plateaus); 3 — Fruit-and-vegetable growing and horticulture; 4 — Arable-and-pasture land (valleys); 5 — Recreation-and-reclamation forest strips; 6 — Recreation area; 7 — Mining area; 8 — Dump area; 9 — Waste water treatment area; 10 — Large-scale construction site; 11 — Area of rural houses; 12 — Compact urban built-up area; 13 — Loose urban built-up area; 14 — Area of single-family housing and villas; 15 — New building grounds; 16 — Residential area with some industry; 17 — Industrial district with some housing functions; 18 — Mixed industrial district; 20 — River port; 21 — Agricultural suburban area; 22 — Post-mining area; 23a — Transportation area, a — compact; 23b — Transportation area, b — extensively utilized; 24 — Miscellaneous

There is hardly space within this paper to cope at length with the effects of brown coal mining upon environmental balance. This topic is dealt with a great many studies. It can only be stressed here that the deeply reaching changes caused by the mining are followed by essential environmental changes, such as those below:

— geosphere/morphosphere — development of new meso- (hollow and solid forms: left-over pits, high dumps) and micro-forms ("moon landscape", depression, hollows, etc.);

— biosphere — total devastation of the natural and artificial vegetation, infestation with weeds, in direct dependence from this — also changes in the animal life;

— pedosphere — absolute devastation of developed soils and replacement thereof by raw dump soils;

— lithosphere — devastation and mixing-up of the top stratum on high land, development of loose dump rocks;

— hydrosphere — changes within the entire water regime within the reach of surficial, ground and subsoil waters;

— atmosphere — development of new conditions, particularly as concerns the micro- and partially also the mezo-climate.

It deserves a stress at this point that also the relations and processes advancing between the newly created components of a post-mining landscape are basically different from those that have prevailed before.

An attempt has been made herein, to demonstrate certain changes within the Halle–Leipzig agglomeration in their natural built-up, and simultaneously hint at possible registration methods. It must be borne in mind steadily while doing so that the above can make only primary attempts of an analytical approach to environment changes within the agglomerations of forming an opinion on them, and of contributing to the finding of solutions answering to the socio-political and land improvement requirements.

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