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CONTEMPORARY URBANIZATION PROCESSES

PROCEEDINGS
OF THE FIRST POLISH-SOVIET GEOGRAPHICAL SEMINAR
SZYMBARK (POLAND) MAY-JUNE 1971

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REPORT OF THE MEETING

The first Polish-Soviet Geographical Seminar took place in Warsaw, Szymbark and Cracow from 22nd May to 1st June, 1971. The theme related to the problems of contemporary urbanization processes and the development of urban-industrial agglomerations. The Seminar was organized on the Polish side by the Institute of Geography, Polish Academy of Sciences and the Institute of Geography, Warsaw University. On the Soviet side the organizers were the National Committee of Soviet Geographers and the University of Higher and Specialized Secondary Education of the USSR.

The Soviet delegation of ten geographers represented six scientific institutions of Moscow and was led by Professor V. V. Pokshishevski. The Polish group consisted of thirty five persons under the leadership of Professor K. Dziewoński.

The Seminar was officially opened in the Institute of Geography, Polish Academy of Sciences on May 22nd, by its Director, Professor S. Leszczycki. On the next day the seminar participants travelled to Szymbark near Gorlice where the meetings took place at the Research Station of the Institute of Geography PAN from 24th to 27th May. Over three days 18 papers and one short report were presented and discussed.

The programme in Szymbark included study-excursions illustrating the themes of the sessions. On 28th May the members of the seminar travelled to Cracow where, on the next day they visited the Institute of Geography, of the Jagellonian University. Excursions in Cracow and its vicinity were also organized. The Seminar ended in Warsaw on 1st June, 1971.

At the end of the meetings in Szymbark the following resolution was accepted:

I

(1) The rapid development and spread of the processes of urbanization on the surface of the Earth is conditioned by objective socio-economic laws. In these processes manifests itself the fundamental law of the development of settlement networks, i.e., the accordance of settlement networks with the mode of social production and with the superstructure (the leading role of the mode of production being preserved).

(2) In the socialist countries, where the development of the national economy and culture proceeds according to plans, urbanization processes are in agreement with the development and distribution of industry, agriculture, transport, organizational-economic functions, administrative and service functions; they are related to the growth of living standards, both in their material and cultural aspects. These processes manifest themselves in the leading role of urban settlements, and in the liquidation of the essential differences between urban and rural living conditions.

(3) Urbanization processes reflect a complex and difficult to control interdependencies that occur between the economic, technological, geographical, demographic and health conditions and development factors. Thus the principle of comprehensively studying all aspects of urbanization should be taken as the point of departure. What is indispensable is the study of facts, trends and regularities in urbanization processes. Research findings should constitute the foundation of planning, management and forecasting of these processes. This goal may be achieved by extending geographical, economic, sociological and demographic studies into comprehensive studies.

(4) The most essential principle in studying urbanization problems is one of comprehensively analysing the development of urban and rural settlements as a uniform settlement system of the whole country. This system is composed of complexes or groups of settlements of different orders (regional, local), and different forms.

(5) The geographical differentiation of the various kinds of urbanization problems in respect to the intensity, scale and dynamics of spatial forms (monocentric, polycentric settlement groupings) etc., and the mutual relations between small, medium-size and larger towns and big cities are conditioned by differences in the development and spatial structure of the national economy. This in turn depends on both the economic and geographical situation, and the specific social conditions, the way of living and the natural conditions of individual countries or regions. A very important factor in geographical differentiation is also the level of urbanization attained; and if a high level has been reached, the attenuation of the growth rate.

(6) In the course of studying the settlement network dynamics, the processes of concentration of both economic and cultural activities have to be taken into account, since they contribute to the growth of large cities and urban agglomerations. The same applies to the trends which tend to level out the living conditions of the population by a more proportionate distribution of settlement groups over the whole country.

(7) In studies of the geography of settlements, special attention must be paid to the explanation of the relationships between the town as a centre, and its surrounding area. The application of mathematical methods is expected to show the economic, social and cultural links that exist between towns as centres and their surrounding areas.

(8) Geographical studies of urbanization processes should be adjusted to serve constructive purposes, especially the practical solution of the spatial planning of the national economy and culture, in the elaboration of projects for regional plans, and projects of plans of development and reconstruction of towns, settlements and rural villages.

II

The following problems relating to the urbanization questions discussed during the seminar should be recognized as the most urgent and be tackled first;

(1) The problems of controlling the spatial development of settlement systems on both a national scale and for individual large regions. In the socialist countries this is possible owing to the planned character of the economic development.

(2) A further deepening of the analysis of the social and demographic aspects of town development and the role of population migration in urbanization processes, in order to create a scientific foundation for a more efficient control of these complex phenomena.

(3) The problems of the effects of social and economic activities in highly urbanized and rapidly urbanizing areas on the natural environment. The elaboration of a system of preventive measures against various types of deformation, and the identification of different ways of enriching the natural environment of

towns in order to secure an adequate level of public health in urban areas, and to create optimal conditions for the development of tourism and recreation.

(4) The further improvement of models of urban development and mathematical analyses for the quantitative study of regularities in the development of towns, and their utilization for forecasting and planning.

III

(1) The participants in the seminar acknowledge their gratitude to all the organizers, especially the Polish Academy of Sciences and Warsaw University, who provided all the facilities for the efficient completion of the Seminar and field studies, and to the State University of Moscow, which printed the texts of reports prepared by the Soviet delegates.

(2) The participants in the seminar emphasize the great advantages of the contacts established during the Seminar. These contacts helped to work out a common methodological position and should be continued. For this purpose it would be useful to organize another bilateral seminar within 2–3 years, with a list of problems adjusted to the new level of knowledge of the urbanization of socialist countries both as form of spatial organization of social life and as the way of transforming the natural environment of urbanized areas in accordance with social needs.

(3) The materials of the present Seminar should be widely circulated. The suggestion to publish the materials in English in Geographia Polonica is accepted. The Soviet delegation agrees to publish their reports in Polish as it will appear necessary, and possible in Polish geographical publications. The Polish delegation agrees to publish its reports in Russian or in the languages of the other peoples of the Soviet Union within the possibilities in Soviet publications.

(4) Reports from the Seminar and the text of this resolution will be published in the scientific geographical journals of both countries.

LIST OF PARTICIPANTS IN THE FIRST POLISH-SOVIET GEOGRAPHICAL SEMINAR

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4. Z. N. Yargina, Institute for Theory, History and Future Development of Soviet Architecture
5. L. N. Karpov, Institute for World Economy and International Relations, Academy of Sciences of the USSR
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Editor's Note:

The papers presented at the Seminar by the Soviet authors were first published in Russian in a collection entitled: *Problemy urbanizatsii v SSSR*, Moskva 1971, and later appeared in Polish in *Przegląd Zagranicznej Literatury Geograficznej*, 1972, No. 1 and in *Przegląd Geograficzny*, 1972, No. 3. The articles in this volume are translations from the above publications. The articles by Polish authors are translations of revised versions of seminar papers.

QUANTITATIVE REGULARITIES IN THE URBANIZATION OF THE USSR

VLADIMIR G. DAVIDOVICH

The spread of urbanization processes is explained through the effects of objective economic laws that are reflected in the growth and location of industry and transport, in the development of economic-management and administrative-cultural functions, and in the degree of agricultural mechanization. An increasing role is also played by the development of the sphere of services for both urban and rural population, with leading role in urban places.

The basic quantitative indicators of the extent, rate and character of urbanization of the country, Union Republics, economic regions, *krays, oblasts* and the individual local systems of towns, settlements and villages are the following:

U_b — urbanization level at the beginning of the study period (urban population in proportion to the national total (%));

U_e — the same at the end of the period in percent;

I — urbanization level increase, in %;

K_u — coefficient of growth of urban population (which shows by how many times the urban population has increased during the period under consideration);

K_r — coefficient of change of rural population (ratio of total figures at the beginning and at the end of the period).

As follows from these definitions that:

$$U_e = \frac{100 K_u U_b}{K_u U_b + K_r (100 - U_b)} \% \ldots \tag{1}$$

If one divides the numerator and the denominator by $K_u \cdot U_b$, one gets:

$$U_e = \frac{100}{1 + \frac{K_r}{K_u}\left(\frac{100}{U_b} - 1\right)} \% \ldots \tag{2}$$

Besides, one can see from the definitions that:

$$I = U_e - U_b = \frac{100}{1 + \frac{K_r}{K_u}\left(\frac{100}{U_b} - 1\right)} - U_b \% \ldots \tag{3}$$

The formulas 2 and 3 suggest the following conclusions:

(1) Changes in the level of urbanization depend not only on the rate of increase of the total urban population, but also on the changes in the total rural population. U_k increases both with and increase in the coefficient K_u, and with a decrease in the coefficient K_r. A decisive role is played by the ratio between these coefficients $a = K_u/K_r$. For example during the 1959–1970 period, in the Tyumen *oblast*, where: $K_u = 1.99$, $K_r = 0.96$, $U_b = 32\%$, $K_u/K_r = 2.07$ and $U_b = 49\%$; in the Smolensk *oblast*, $K_u = 1.45$, $K_r = 0.74$, $U_b = 32\%$, $K_u/K_r = 1.96$ and $U_e = 48\%$. The almost identical increase of the urbanization level (17 and 16 percentage points) was, in the Tyumen *oblast*, a result of a rapid growth of the urban population total, with a negligible decrease in the rural population, while in the Smolensk *oblast* it was a lesser rate of growth of the total urban population, and a very sharp decline in rural population. If the K_r coefficient in the Smolensk *oblast* have been identical to that in the Tyumen *oblast*, i.e., $K_r = 0.96$, the result would have been in accordance with the formula (2):

$$U_e = \frac{100}{1 + \frac{0.96}{1.45}\left(\frac{100}{32} - 1\right)} = 42\%$$

This means that the level of urbanization would have been 6% lower.

(2) The changes in the level of urbanization are affected not only by the ratio $a = K_u/K_r$, but also by the level already achieved at the beginning of the period U_b (see Table 1 computed by formula 3).

TABLE 1. Increase in the level of urbanization (I) depending on U_b and $\frac{K_u}{K_r}$

$\frac{K_u}{K_r}$	Value of I (%) at U_b (%)								
	10	20	30	40	50	60	70	80	90
1.1	0.90	1.58	2.05	2.30	**2.41**	2.30	2.94	1.53	0.88
1.2	1.77	3.10	3.96	4.47	**4.55**	4.32	3.68	2.73	1.53
1.3	2.63	4.53	5.72	6.43	**6.55**	6.10	5.20	3.87	2.18
1.4	3.47	5.93	7.50	8.30	**8.37**	7.80	6.58	4.76	2.67
1.5	4.29	7.20	9.10	**10.00**	9.70	9.20	7.80	5.40	3.20
1.6	5.09	8.58	10.68	**11.64**	11.56	10.60	8.95	6.53	3.50
1.7	5.89	9.84	12.20	**13.16**	13.00	11.87	9.90	7.20	3.90
1.8	6.67	11.05	13.67	**14.57**	14.33	13.00	10.80	7.80	4.20
1.9	7.43	12.24	14.90	**15.90**	15.55	14.07	11.60	8.40	4.50
2.0	8.18	13.33	16.18	**17.15**	16.67	15.00	12.40	8.90	4.80
2.5	11.75	18.50	21.70	**22.50**	21.40	18.95	15.40	10.90	5.80
3.0	15.00	23.18	26.30	**26.67**	25.00	21.80	17.50	12.30	6.50
4.0	20.77	30.00	**33.13**	**32.73**	30.00	25.70	20.30	14.10	7.30
5.0	25.73	35.56	**38.20**	**36.92**	33.33	28.27	22.13	15.20	7.80

You can see from Table 1 and Fig. 1, the increase in the level of urbanization ($I - U_e - U_b$), while assuming the same ratio of the coefficients, $a = K_u/K_r$, is negligible at low values of U_b (e.g. when $U_b = 10\%$). It rises as U_b increases reaching its maximum when $U_b = 50$ or 40 or 30%, and then I declining. This depends on the functional relation of the coefficient I with K_u/K_r and U_b (see the formula 3). Consequently the initial period of urbanization (of a country or

oblast) is marked by a steadily increasing level of urbanization ($U_e - U_b$), while the final period when urban population exceeds more than one half of the national total population, would show a trend toward slowed growth. This conclusion is true with constant rates of increase in the total urban population (and with the constant coefficients of the rural population figure decreasing), and the more so when this rate is decreasing.

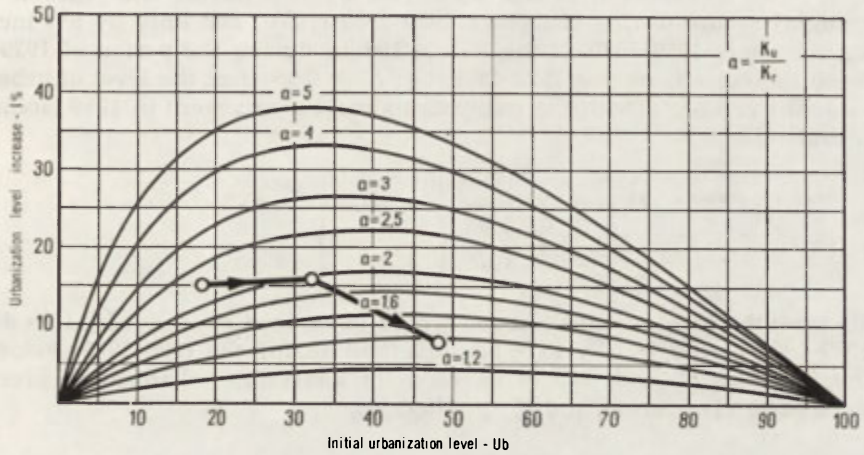

Fig. 1. Increase in the level of urbanization depending on the ratio of the coefficient of the increase in the urban population to the coefficient of the change in the rural population (K_u/K_r) and on the initial level of urbanization (U_b)

(3) The index figures of urbanization towards the end of the study period (U_b), and the increase in the level during that period (I), ultimately depend on the relationships between the indicators K_u, K_r and U_b (see Table 2).

TABLE 2. Basic indices of urbanization processes in the USSR*

Urbanization indices	Index value during the periods		
	1926–1939 (12 years)	1939–1941 and 1949–1959 (12 years)**	1959–1970 (11 years)
K_u	2.13	1.66	1.36
K_r	0.95	0.84	0.97
$\frac{K_u}{K_r}$	2.29	1.98	1.40
U_b	18	32	48
I	+15	+16	+8
U_b	33	48	56

* Calculated from data published in the annals of the Central Statistical Office of the USSR: *Narodnoye Khozyaystvo SSSR v 1969 g.*, Moskva 1970, p. 7, and *Narodnoye Khozyaystvo SSSR v 1963 g.*, Moskva 1965, pp. 7–8.

** Not including the urban population of war years and the period of reconstruction.

The rates of the growth of the urban population (K_u) have been declining. The decline of rural population (K_r has become more accelerated during the 1939–1959 period (as a result of the war and rural-urban migrations), but this process slowed during the period 1959–1970. That is why the ratio K_u/K_r has declined only slightly during the 1939–1959 period (compared with the 1926–1959 period), but sharply dropped during the years 1959–1970.

As a result the level of urbanization rose by 15% during the years of 1926–1939, slightly more during the years 1939–1959 (16%), and only by 8% increase during the years 1959–1970. If the K_r coefficient during the period of 1939–1959 had been the same as during 1926–1939, i.e., $K_r = 0.95$, then the level of urbanization would have been (with the indicators almost unchanged) in 1959 (according to Formula 2):

$$U_e = \frac{100}{1 + \frac{0.95}{1.66}\left(\frac{100}{32} - 1\right)} = 45\%$$

In this case, the level of urbanization would have been risen not by 16% during the 1939–1959 period, but by 13%, i.e., less than during the 1926–1939 period.

The formulas (2) and (3) can be used for analysing urbanization processes during a particular period, and for predictions.

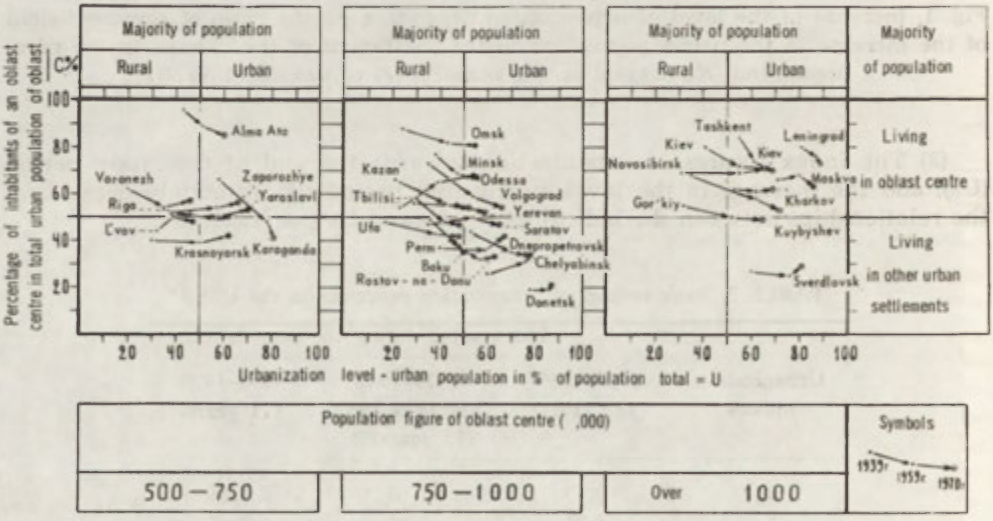

Fig. 2. Changes in the level of urbanization (U), and in the share of the population of the *oblast* centre (C) as % of the total *oblast* urban population

The set of main quantitative urbanization indicators must be supplemented; it is important to establish the degree of concentration of population in the *oblast* capital, to determine its own role (in the increase of the urbanization level), and the role of all other urban places in the *oblast*.

Introduce the following:

C_b — the initial proportion of the population of *oblast* capital to the total urban population of the *oblast* (in %);

C_e — the same at the end of the period in question;
K_c — coefficient of the total increase in the population of the *oblast* capital;
K_o — the same, for all the other urban places in the *oblast*.

Using these definitions, we can find the mean coefficient of urban population growth (including both the *oblast* capital and all other urban places):

$$K_u = \frac{K_c C_b + K_o(100 - C_b)}{100} \ldots \quad (4)$$

For example, in Kuybyshev *oblast* during the period 1959–1970, were $C_b = 58\%$, $K_c = 1.3$, $K_o = 1.56$.

$$K_u = \frac{1.3 \cdot 58 + 1.56(100 - 58)}{100} = 1.409 \approx 1.41$$

i.e., the growth in urban population in the *oblast* was 41%. Of this figure, 17.5% was a result of the increase in the population of the city of Kuybyshev, and 23.5% accounted for the city of Togliatti and the remaining urban settlements of the *oblast*.

It is also easy to determine the proportion of the *oblast* centre population to the end of the period:

$$C_e = \frac{100 K_c C_b}{K_c C_b + K_o(100 - C_b)} \% \ldots \quad (5)$$

When one divides the numerator and the denominator by $K_c C_b$ one gets:

$$C_e = \frac{100}{1 + \frac{K_o}{K_c}\left(\frac{100}{C_b} - 1\right)} \% \ldots \quad (6)$$

For the city of Kuybyshev by the end of the 1959–1970 period:

$$C_e = \frac{100}{1 + \frac{1.56}{1.30}\left(\frac{100}{58} - 1\right)} = 53\%$$

Consequently, the share of population of the city of Kuybyshev of the total urban population of the *oblast* (including the city of Kuybyshev), declined during the 1959–1970 period, from 58% to 53%. This decline was the result of the higher rates of growth in the population of other towns and settlements of the district ($K_o = 1.56$) compared with that of Kuybyshev ($K_c = 1.30$).

The differences between C_b and C_e shows up the shifts in the concentration of urban population in the *oblast* center (Table 3).

As Table 3, shows, that out of 32 largest Republic and *oblast* capitals with more than 500 thousand inhabitants in 1970, the proportion of the total urban population has decreased in 20 centers, was unchanged in 2 centres, and increased slightly only in 10 centres (from 1939 to 1970). A steady tendency has thus developed; for a decline, in the share of administrative centres of this country, in the total urban population of the Republics or oblasts. However, the majority of capitals (100–500 thousand), middle (20–100 thousand) and small (up to 20 thousand inhabitans) centres were growing more quickly than the other urban places in their *oblast*.

TABLE 3. Changes of the share of *oblasts* and republic capitals in the total urban population of *oblasts* and republics*

No.	Centres of districts, Union and Autonomous Republics	C_b % 1939	C_e % 1970	$C_e - C_b$ %
1	Moscow	66	63	−3
2	Leningrad	80	73	−7
3	Kiev	80	71	−9
4	Tashkent	83	70	−13
5	Kharkov	62	62	0
6	Gorki	55	49	−6
7	Novosibirsk	69	71	+2
8	Kuybyshev	68	53	−15
9	Sverdlovsk	27	29	+2
10	Minsk	54	68	+14
11	Odessa	77	67	−10
12	Tbilisi	58	47	−11
13	Donetsk	19	21	+2
14	Chelyabinsk	26	34	+8
15	Kazan	66	54	−12
16	Dnepropetrovsk	44	34	−10
17	Perm	37	42	+5
18	Baku	49	35	−14
19	Omsk	88	81	−7
20	Volgograd	73	54	−19
21	Rostov-on-Don	40	33	−7
22	Ufa	48	42	−6
23	Yerevan	56	52	−4
24	Saratov	47	47	0
25	Riga	53	50	−3
26	Alma Ata	96	85	−11
27	Voronezh	62	57	−5
28	Zaporozhye	52	56	+4
29	Krasnoyarsk	40	42	+2
30	Lvov	44	48	+4
31	Karaganda	66	41	−25
32	Yaroslavl	51	53	+2

* Calculated from data published in the annals of the Central Statistical Office of the USSR: *Narodnoye Khozyaystvo SSSR v 1969 g.*, Moskva 1970, pp. 13–28, and in the publication of the Central Statistical Office of the USSR: *Itogi Vsesoyuznoi perepisi naseleniya 1959 g.*, SSSR, Moskva 1962, pp. 20–29.

The value of K_u, from formula (4), may be substituted in formula (2):

$$U_e = \frac{100}{1 + \frac{100\ K_r}{K_c C_b + K_o(100 - C_b)} \left(\frac{100}{U_b} - 1 \right)} \% \ldots \qquad (7)$$

dividing numerator and the denominator by 100:

$$U_e = \frac{1}{0.01 + \frac{K_r}{K_c C_b + K_o(100 - C_b)} \left(\frac{100}{U_b} - 1 \right)} \% \ldots \quad (8)$$

This formula expresses the functional relationship between the level of urbanization at the end of study period (U_e), from the following indicators:

(1) urbanization level at the beginning of the period in question (U_b);

(2) proportion of the population of the *oblast* centre (as a percentage of the total urban population of the *oblast*) at the beginning of the period in question (C_b);

(3) coefficient of the population growth of the *oblast* centre (K_c);

(4) coefficient of the increase in the population growth of all the other urban places in the *oblast* (K_o);

(5) coefficient of the changes in the total rural population of the *oblast* (K_r).

Apart from these, in analysing urbanization processes, the following indicators may be taken into consideration: increase in the level of urbanization during the study period (I — formula 3); coefficient of the increase in the total urban population of the *oblast* (K_u formula 4); proportion of the *oblast* capital population at the end of the period in question (C_e — formula 6). Formulas 3, 4, 6 and 8 taken together thus express relationship between nine urbanization indicators, its initial state at the beginning of the period (U_b and C_b), the processes during the period (K_c, K_o, K_u, K_r), and the results at the end of the period (I, U_e and C_e). This is a comprehensive system of mathematical formulas for an analysis of the urbanization processes.

To clearly demonstrate the effect of these or other factors on the values I, U_e and C_e, and to compare their changes in the various *oblasts* and local groups of towns, municipal settlements and villages, a graphical analytical model of the urbanization processes is given below (Fig. 3). It consists of two nomograms. The first bottom left is based in accordance with formulas (4) and (6): the other (consisting of the two squares) is based on formulas (2) [1] and (3).

The nomograms are linked by diagonal arrows indicating that the K_u values determined in the first nomogram are to be transferred to the second one.

The nomograms contain plotted outlines (in bold dotted print with arrow marks) corresponding to the processes of urbanization in the *oblasts* of Pavlodar, Kuybyshev and Donetsk during 1959–1970. These are examples of different types of urbanization processes. The rapid development of mining industries in Pavlodar *oblast* has caused fast rates of growth in the city of Pavlodar ($K_c = 2.07$), and particularly in the other urban settlements ($K_o = 3.62$). Because of the higher rates of growth in the other settlements, the share of the latter in the total urban population of the *oblast* dropped from 68 to 55%. With a coefficient of growth of the total urban population of $K_u = 2.57$, the rural population also increased, but to a lower level ($K_r = 1.11$). Therefore, the level of urbanization sharply increased by 20% absolute (from 29% to 49%).

Industry in Kuybyshev *oblast* did not develop as rapidly as that in the Pavlodar *oblast*, but still at quite a rapid rate. The city of Kuybyshev also grew slower than the other urban places in the *oblast*. The proportion of

[1] When plotting nomograms, it is more convenient, instead of using formula (8), to apply formula (2) which enables an identical analysis to be made (in combination with formula 4).

the *oblast* centre has declined 5% (from 58% to 53%). Despite the high level of urbanization achieved in 1959 ($U_b = 62$) this figure increased by 10% by 1970 due not only to the growth of the total urban population ($K_u = 1.41$) but also to the decline in the rural population ($K_r = 0.91$).

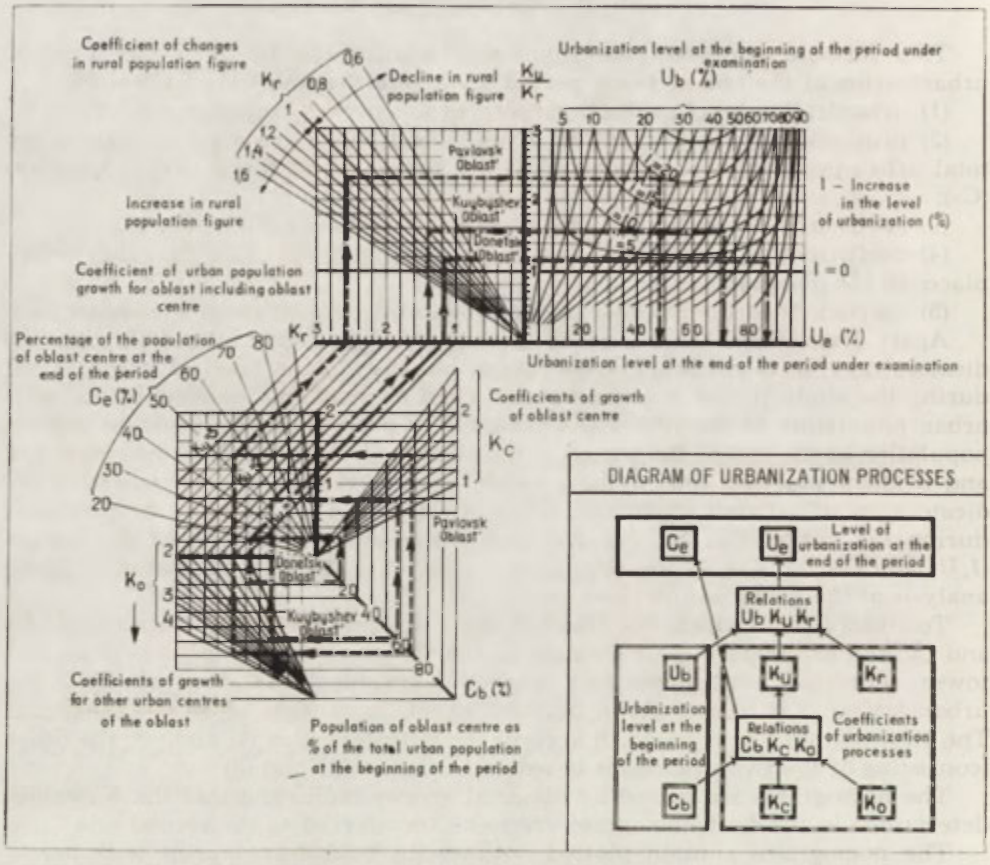

Fig. 3. A graphic analytical model of urbanization processes

In 1959 the Donetsk *oblast* was one of the most highly industrialized of the USSR, with a very high urbanization level ($U_b = 86$). The further development of industry, public transport, and of the other branches of the national economy (1959–1970), has been preceeded relatively slowly, the total urban population rose by only 17% ($K_u = 1.17$). A feature characteristic of highly developed coal basins is rather low share of the *oblast* capital ($C_b = 19$) in total urban population of the *oblast*. The rate of growth of the city of Donetsk ($K_c = 1.24$) is a little higher than that of the other urban settlements of the *oblast* ($K_o = 1.15$) and the share of the former has increased, but, only by 2% ($C_e = 21\%$). The total rural population has increased negligibly ($K_r = 1.02$), and the level of urbanization rose only by 1% ($U_e = 87\%$).

An example of a distinctive type of urbanization process (typical of the Republics of Central Asia and of most of the Kazakhstan *oblasts*) may be illustrated by case of the Kirgiz Soviet Socialist Republic. Despite a low level

of urbanization in 1959 ($U_b = 34\%$) and the rapid growth of urban population total during 1959–1970 ($K_u = 1.58$), the increase in the urbanization level was negligible, only by 3% ($U_e = 37\%$). This has resulted from a simultaneous, though less rapid, growth of the total rural population ($K_r = 1.34$ and $K_u/K_r = 1.18$).

Another type of urbanization process (typical of many *oblasts* in the Western part of the USSR) may be illustrated by Kostroma *oblast*. Despite slow rate of growth of the total urban population ($K_u = 1.27$), the level of urbanization during the 1959–1970 period rose 13%. This is a result of a rapid decline in the total rural population ($K_r = 0.73$) as well as the low initial level of urbanization ($U_b = 40\%$).

These examples do not exhaust all the types of urbanization.

To outline the basic urbanization tendencies, it is necessary to analyse the growth of the urban population for different sizes of cities and urban settlements — small, middle, large and very large (with the exception of Moscow and Leningrad). An explanation of changes of urban population within and between these groups of towns is essential (Table 4).

TABLE 4. Growth of population during 1959–1970 by Groups of Urban Places (size classes as of 1959 and 1970)

Groups of urban places of various sizes		Population (millions)		Growth coefficient	Population increase		Share in total urban population (%)	
size category	population (in thousands)	1959*	1970		(millions)	%	1959	1970
Moscow* and Leningrad	over 3000	9.0	10.5	1.16	1.5	4.2	9.0	7.7
Very large cities	500–2000	15.7**	26.8	**1.71**	11.1	31.0	15.7	19.7
Large cities	100– 500	24.5	**38.3**	1.56	**13.8**	**38.5**	24.4	**28.2**
Middle cities	20– 100	25.6	31.5	1.23	5.9	16.5	25.5	23.2
Small towns	Under 20	25.4	28.9	1.14	3.5	9.8	25.4	21.2
Total		100.2	136.0	1.36	35.8	100	100	100

* with the new boundaries of Moscow (1960).

** the city of Yerevan not included, since its population was 493,000 in 1959 (within the present boundaries of the city).

Because of the high rates of growth of the urban population figures of the very large cities, it has been suggested that the concentration of population in these cities is the main tendency of development. The highest population increase, however, is seen not in the category of very large city, but in the large one. The "central figure" of the urban settlement movement has become cities with 100–500 thousand inhabitants, in which 28.2% of the total urban population is concentrated (in 1970), compared with 19.7% in the very large cities. The rapid increase in the total population within the group of the largest cities occurred during the 1959–1970 period basically the result of this group having been joined by other cities which numbered less than 500 thousand inhabitants in 1959. The increase in the number of inhabitants of the very large cities will be smaller still in the future than that in the large ones, as there are many

"candidates" for inclusion in the 500 thousand inhabitants category than those in the 100–500 thousand category.

An interesting explanation has been given for the rate of growth and absolute increase in the population total for groups of cities which reached (in 1970) 500–2000 thousand inhabitants, or of 100–500 thousand inhabitants respectively, and so on. (Table 5), even though some of them could be included in lower size classes in 1959.

TABLE 5. Growth of population during the period 1959–1970 by Groups of Urban Places (according to size classes as of 1970)

Size groups of urban settlements as of January 15, 1970		Population (millions)		Growth coefficient	Population increase		Share in total urban population (%)	
size category	population (in thousands)	1959	1970*		(millions)	%	1959	1970
Moscow and Leningrad	over 3000	9.0	10.5	1.16	1.5	4.9	9.0	8.0
Very large cites	500–2000	19.6	26.8	1.37	7.2	23.4	19.6	20.5
Large cites	100–500	26.8	38.3	**1.43**	**11.5**	**37.3**	**26.7**	**29.2**
Middle, small towns and urban type settlements	under 100	44.8	55.4*	1.24	10.6	34.4	44.7	42.3
Total		100.2	131.0	1.31	30.8	100	100	100

* With the exception of increment that results out of reclassification of rural settlements (with 5 million heads of population) into towns.

Table 5 shows that the rates of growth of the very large cities were somewhat lower than that of large cities, with much smaller increase in the total population; the share of the total population in the very large cities rose by only 0.9%, and 2.5% as in large cities. The lowest coefficients were those of Moscow and Leningrad (1.16). Their share of the total urban population declined from 13.7% (in 1926) to 7.7% (in 1970 — see Table 4). All the figures available do not support a view of an overwhelming concentration of population in very large cities. These share should decline because of the firm policy of limiting the growth,[2] and towards the development of numerous middle and small cities instead.

The processes of urbanization must be examined within territorial settlement systems of different order:

(1) a unified system of urban and rural migration encompassing the whole of the USSR;

(2) of regional systems, to include several economic regions closely linked with one another (e.g. the Ukrainian SSR or the Central Asian of Kazakhstan region);

[2] Directives by the 24th Congress of the Communist Party of the Soviet Union, on the plan of the development of the national economy of the USSR for 1971–1975.

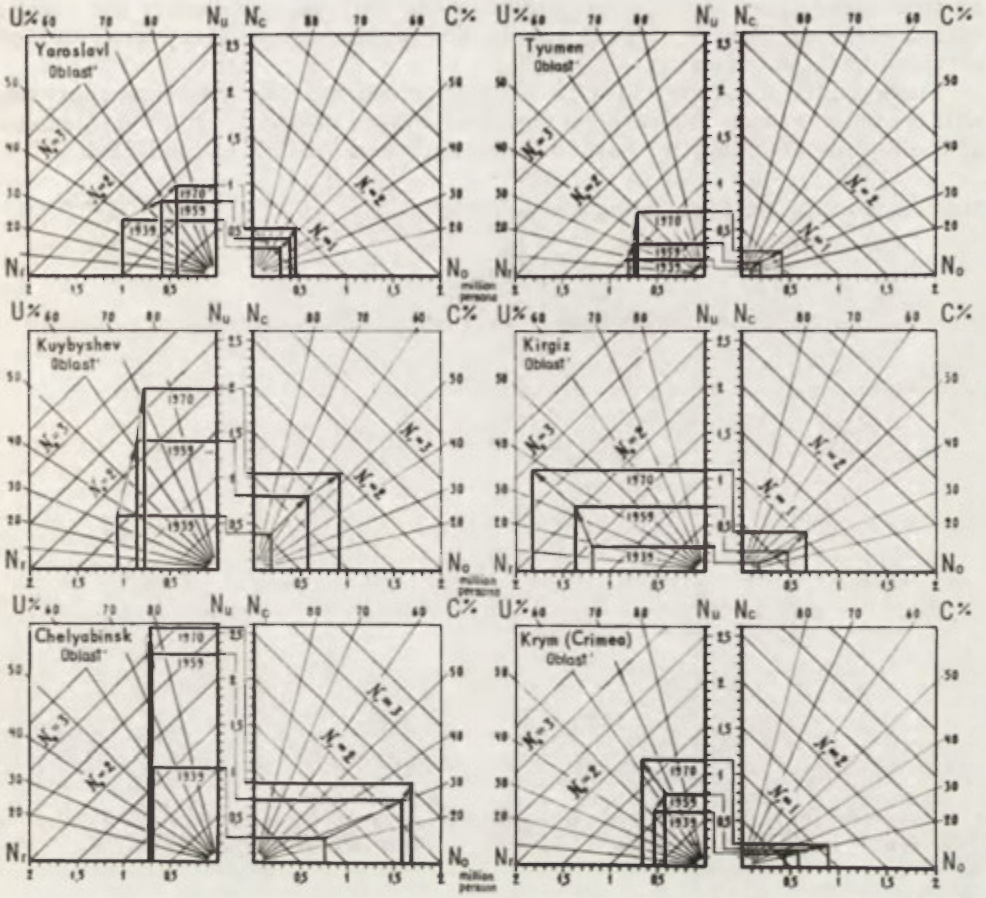

Fig. 4. Examples of different types of urban development

(3) within economic regions;

(4) of the individual Republics (incorporated in an economic region for instance, the Baltic and Trans-Caucasian ones), *oblasts* and *krays*;

(5) of local groups of places, urban settlements and villages — from small systems to those of the largest agglomerations. The author of this article has studied the regularities and trends of migration over the territory of the USSR, i.e., of a unified settlement system as well as tasks faced by the future planning of such a system, in many of his works[3]. Such problems must be solved as

[3] Book references:

Planirovka gorodov (1947); *Rasseleniye v promyshlennykh uzlakh* (1960); *Planirovka gorodov i rayonov* (1964).

Articles:

in: *Arkhitektura SSSR* (1957, No. 7); in *Voprosy Geografii* No. 38 (1956), No. 45 (1959), No. 56 (1962), No. 66 (1965);

in the volume:

Nauchnye problemy geografii nasseleniya. Published by Moscow State University (M.G.U.), 1967; in: *Vestnik M.G.U. Geografia* (1968, No. 6), and in:

V pomoshch proyektirovshchiku gradostroitely, *Problemy gradostroitelstva,* No. 1 (1970).

an inseperable part of the development of the national economy of the USSR; of industry, agriculture, power supply and public transport system, and of services (in its broad sense).

Further investigations on the patterns of urbanization by a systems approach will contribute to the improvement of the methods of control and management of the development of cities, urban settlements and villages in the USSR.

Moscow Institute for Engineering and Economy

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MAJOR RESEARCH TRENDS IN THE SETTLEMENT GEOGRAPHY IN POLAND

Maria Kiełczewska-Zaleska

I

The study of settlements is part of geography, and thus its methods and scope of research evolve along side the theoretical developments of the whole science of geography. The development of geography is associated on the one hand with the general development of science, and on the other, with the immense accumulation of information about the world and its changes. Modern communications — television, broadcasting, the press — have facilitated a rapid flow of information not only about the events of political life but also of economic, natural and cultural phenomena. The global information system has furnished permanent communication between the nations of the world, and has attracted the interest of governments, politicians, economists and journalists. There are many articles and reports being published on countries, regions and towns, containing a great deal of useful geographical information. Through these reports, which are mainly written by non-geographers, today's readers try to satisfy their demand for information about the world. Earlier, geography fulfilled the function of providing information about the world. Now it has lost control over this field. At present geography is not the provider of information about the world, but it facilitates its understanding and interpretation. The large number of people engaged in supplying information about the world ought to have some education in geography if their information is to be of the highest possible calibre. Thus we come across the problem of the relation of the information to scientific thinking, which is the concern of geography, for this science is steadily divorcing itself from traditional description and factual information. Scientific thinking transforms information, data, facts, and observations by the different methods employed by the various geographical sciences and by the branches of geography. The emergence of the different branches of geography resulted from both their different research subjects and various zones of contacts between these branches of geography and other groups of sciences.

Settlement geography developed into an independent branch of geography because it both comprised and had to draw on sciences that were not linked to other branches of the subject. Thus settlement geography occupies a borderland with a number of sciences, all of which shape its development. They include economics, sociology, ethnography, town planning, economic history and cultural history.

II

The emergence of settlement geography as a fully independent branch of geography was in Poland, as in other countries, rather slow. Its development can be divided into several phases. Because it is difficult in a concise report to give a detailed description of the specific features, of the works and achievements of each phase, I want to bring out only some general features and differences. The geography of settlements evolved in the period when Poland was not politically independent (the 19th century), when there was little opportunity to discuss questions of current interest, and studies on settlements mainly had an historical bent. The period of 1918–1939 witnessed a rapid development of anthropogeography in Poland, of which settlement study formed a major part. Studies on urban and rural settlements plus detailed field studies grew rapidly. The regaining of Poland's national independence made it possible to carry out freely field studies, landscape observations as well as of phenomena relating to human life and human artifacts. The fact that geography was conceived of as the science of the landscape stimulated this development in the geography of settlements. This trend developed in all university centres, but with different intensity and with different research interests. The principal feature of this phase of development of the subject was what may be called the "double-track" trend in human geography. One line of development was anthropogeography; its principal aims of enquiry were the relations between human activities, objects built upon the earth's surface, and nature. The mutual relations between man and his natural environment constituted the main problem of theoretical considerations and was also the key problem in individual studies. Geographical determinism adversely affected some of these studies, and the study of the geography of man only slowly managed to free itself from these effects. Nevertheless, the geography of settlements in the inter-war period produced a number of valuable studies; it provided a knowledge of diverse forms of settlements from the physiognomical point of view, and drew attention to the changes occurring in settlement processes.

Parallel with anthropogeography (which included the geography of settlements) economic geography was developing in the inter-war period. In Poland these two sciences developed in partial isolation from each other. Economic geography was conceived of very narrowly and dealt primarily with the description and distribution of world production. This approach was manifested not only in textbooks for university students but also in the major pieces of research. It provided answers to questions on where and how much was being produced at that time, but did not analyse the essential links between production and the settlement network. Economic geography tackled industrial and transport statistics but ignored man and his settlements, as this was a field of research in anthropogeography. Only Cracow University had some interest in economic geography and economic problems within the geography of settlements, as seen in the town monographs prepared under the supervision of Ludomir Sawicki. This seems to account for the fact that the Cracow centre was the first to use the name economic or socio-economic geography, which came to be used synonymously with anthropogeography. In the other university centres economic geography and anthropogeography were developing in isolation, and anthropogeography did not include large scale economic problems.

After the Second World War human geography at first resumed the same trend it had developed before 1939. It was only in the 1950's that a breakthrough took place. After several years of methodological discussion in which Marxist methodology played and important part, there occurred what one might call a process of economicization of anthropogeography. This found its

expression not only in the substitution of the term economic geography for anthropogeography but also in shifting towards economic phenomena in research studies. The study of settlement as an element of the landscape, of its physiognomy and situation in the environment, was superseded by economic problems. What do people in the settlement engage in? What fixed assets in the settlements are adjusted to its economic role? — these are the principal research themes. The inclusion of such problems into the studies of settlement geography had its obvious advantages but simultaneously many fields of physiographic study were narrowed and earlier research directions were abandoned, especially so because the changes introduced then were heavily affected by the dogmatic tenets of the 1950's. But that period already belongs to the past, and though it adversely affected the studies in some fields, it provided a foundation for the development of future economic geography.

The most recent changes in human geography, that is those of the last ten years, followed the direction laid down still in the 1950's, when several independent sections began to develop the geography of settlements, agriculture, manufacturing, and transport and communications. Each of these separate branches of geography developed into independent disciplines. Throughout the centuries, the development of geography has always developing along two dichotomous lines. First, there was a general research trend, whose main aim was the identification of the features and the classification of phenomena, and the elucidation of their governing laws. Second, there developed a regional trend, which comprised all the phenomena found in an area, and dealt with the spatial differentiation of phenomena over the earth's surface. The division of human geography into several specialized branches resulted primarily in the development of the first of the two trends. It is characterised by an effort to establish regularities and theoretical generalizations which explain various phenomena, and for the factors determining their development. For this purpose it is necessary to abandon statistical descriptions in favour of a more dynamic interpretation of changes. The analysis of processes through the developmental method became the foundation for interpreting phenomena in the geography of settlements and in all other sections of economic geography. At the same time there was an intensive search for more comprehensive theories, in order to generalize the processes under observation. This is another trend to be found in more recent Polish studies on the geography of settlements.

III

Contemporary geography of settlements in Poland shows a strong connection with the evolution of world geography, especially with the development of the geography of settlements in the USA and Great Britain, Sweden, France and in the socialist countries. The new trends in the studies from these countries are soon taken up and freely adjusted to the needs experienced in our own country. This has opened new avenues of development and has led to high level studies which have attracted interest in many other countries. Studies in recent years have considerably extended their research problems. The settlement as an element of socio-economic life has become the subject of a wide variety of studies. It therefore appeared necessary to look to the sciences that dealt with the problems of social and economic life that is to economics, sociology and demography. Moreover the knowledge of mathematical and statistical methods had to be deepened. The borderland between these sciences became occupied by a new distinctly economic trend within settlement geography. It seems that this trend has nearly obliterated the geographic character of the approach to settlements. In place of the previous heavy emphasis on the spatial and physiognomic

differences between settlements, there is an emphasis on the economic features and differences between individual settlements, expressed by various types of numbers and indices.

This is still a predominant trend, though it has already lost its overwhelming domination. The merits of studies on the physiognomy, appearance and plan of settlements are now accepted. To put it briefly, we now have to deal with a broad range of research problems, far broader than during the initial phases of the development of settlement geography. The most important current research problems are those that border on two or more different sciences, and these show the greatest growth. Problems of changes in settlements, of the processes of transformation of both economic phenomena connected with settlements, and the fixed assets of the settlements themselves, appear in all of the more interesting studies. The emphasis on the role of the process, that is of the dynamics of phenomena in geographic studies, is connected with the trend in formulating prognoses. This has been increasingly necessary for planners. If one knows which phenomena give rise to particular processes, then prediction is simply a matter of drawing conclusions from the observed processes, conclusions which can affect the future in general, and in particular may help us control these phenomena in the future. Well thought out predictions formulated in terms of possibilities, can be made and have appeared in recent geographical studies. Thus a well-defined problem, a process elucidating the essence of the changes, and a prediction relating to spatial phenomena, are the specific features of the more recent studies in settlement geography. This pattern has also been adopted in many Polish studies.

The research problems of Polish studies on the settlement geography can be divided into those:

(1) on the urban functional structure, that is on the economic base of towns,

(2) on the settlement network,

(3) on urban agglomerations,

(4) on the internal differentiation of towns, that is on their functional-spatial structure,

(5) on the urbanization processes of rural areas,

(6) historic geographical studies on both rural settlements and studies on the plans of towns and their physical structures,

(7) theoretical-methodological studies and studies on the methodology of settlement geography.

Analyses of the urban economic base, that is of the functions of towns, were first carried out in monographs on small towns. These studies disclosed the growing crisis of the small towns in Poland in the transitional period to a socialized economy in the 1950's. Geographers made important contributions to the knowledge of this subject, and the success in this field indicated the necessity for further broad studies on the urban functional structure and the economic base. Such studies can be divided into several periods. The initial period was limited to a comparative approach to the structure of the employment of the economically active population. It was then that the first functional classification of Polish towns was made (J. Kostrowicki 1952, L. Kosiński 1958). This was also the time when notions of city-forming functions and complementary functions became popular, and the statistical methods for calculating employment indices were introduced into the analysis of the employment structure. But these studies often led to superficial generalizations about phenomena, due to statistical data being centrally compiled, resulting in a formalistic approach, which aid not always correspond to reality. Field studies on individual towns

were also carried out at this time, which supplemented the purely statistical approach to the problem of the urban economic base. These field studies involved the collection of observations and statistical data using direct information. At the same time they provided the foundation for a verification of the results obtained using the centrally collected statistical data. The main purpose of the field studies, however, which was strongly emphasised in all the university centres of geographic research, was the assessment of the urban functions in non-urban areas, and the explanation of the links between the town and its hinterland. Thus, together with the study of urban functions there developed a new problem, that of the region, of the area of economic influence of towns. The study of the urban hinterland and service regions (L. Kosiński 1967, A. Werwicki 1965, M. Kiełczewska-Zaleska 1967) added to the knowledge of the role of the service functions of towns. Moreover, it encroached on the scope of the notions of the city-forming and complementary functions, because the service functions appeared also to be largely city-forming. The increasing depth of these theoretical studies on the urban economic base (K. Dziewoński 1967) opened the third stage in the study of the urban functional structure. This period is again characterized by comparative studies on the employment indices in individual towns usong sophisticated mathematical and statistical methods, and by a more frequent inclusion of the role of central places.

Studies on the urban functional structure are parallelled and complemented by those on the settlement network and its changes. Polish researches working in this field were influenced, on the one hand, by W. Christaller and critics of his theory, and on the other, by the well-developed studies on the economic region and economic regionalization carried out through the International Geographic Union and the Regional Science Association. Deeper analyses of the location and regionalization of economic phenomena brought up the role and importance of the differentiated settlement network. According to K. Dziewoński, this newtork "is a fundamental and characteristic phenomenon of social and economic development, and the notion itself is a principal element of the theory of location". The introduction of such a broad meaning to the notion of the settlement network leads to further studies on defining its characteristics. The move from the notion of a network as a system of service centres to a system of towns with their multiple links was possible with the numerous analytical (A. Wróbel 1960; M. Jerczyński 1971) and theoretical and deductive studies (K. Dziewoński 1968; A. Wróbel 1965).

Studies on the settlement network and its evolution also brought up the necessity of defining the problem of urban agglomerations in geographical studies. Studies in this field developed only recently in Poland, especially on problems of the largest industrial conurbations (M. Dobrowolska 1958; J. Rajman 1965) and on the delimitation of the agglomerations and their internal structure (E. Iwanicka-Lyra 1969; P. Korcelli 1969).

Studies on the internal differentiation of towns have a long tradition in Poland. The direction of research on construction development and the landscape types of town plans and their functional districts, had already taken shape in the inter-war period. Contemporary studies refer to this pre-war research in an effort to provide the details of land use in towns. Less frequently they consider the infrastructure of the town, as in the French studies (for example J. Beaujeu-Garnier). Little is known about the effect of the hierarchy of socialized institutions on the development of the infrastructure of the socialist town, especially large and medium-sized ones. Research on such problems is in progress. There were also attempts to assess the social zoning of towns, but

from the point of view of the social origin of the population rather than of their occupations. Sociological studies on the town as the ecological environment of man are very advanced in Poland. Geography has so far not contributed very much to these problems, which belong more to the borderlands between sociology and town-planning; it is concerned more in the demographic problems of towns. Studies on the population, and its distribution in the town, on the links between population and the functional-spatial structure, have been taken up and revealed interesting results (A. Jelonek 1969; K. Bromek 1964; *Studia z geografii...*, K. Dziewoński *et al.* (eds.) 1971).

An important and well-developed line of research including sociological aspects, is that on the urbanization processes found in rural areas. In Poland a considerable percentage of the rural population work in manufacturing and commute to work. The effects of commuting on towns are remarkable, both in the style of life and their physical appearance. Studies on these processes were developed earliest in Cracow, where, under the guidance of M. Dobrowolska, a group of researchers working on socio-economic problems of urbanization was formed (J. Herma 1966; T. Jarowiecka 1970; L. Pakuła 1970; J. Rajman 1968). This research trend includes detailed field studies, covering population processes, migrations, employment structure as well as the changes in family life, in family budgets and life of the rural areas. The role of socialized institutions and organizations in the settlement network is also analysed in detail. These studies are meticulously documented analyses of the most recent proceses observable in rural areas that are being urbanized under the impact of industrialization. The studies have shown the southern areas of Poland, which had been known for rural overpopulation and for notorious poverty, to have emerged from this backwardness under the influence of industrialization, and to have changed into an industrial-agricultural region maintaining the old local links.

A similar development can be seen in the studies carried out in the Wrocław centre under the supervision of S. Golachowski (1966). The studies from this centre are, moreover, founded upon a more comprehensive theoretical basis. There, new formulations of terminology and methods were proposed which facilitates analyses of the present day processes (A. Zagożdżon 1968).

A revival of sorts is to be observed in historic-geographical studies of settlements. Placing the geographical processes, that is geographic phenomena, into time and space dimensions justified the importance of historical methods. This is an important part of settlement geography for it helps maintain an historical edge in geography. Therefore, along with the mathematical-statistical trend, which must be acknowledged for its remarkable contributions to the development of quantitative methods, historic-geographical studies are also developing. There are historic-geographical studies covering the development of both the functions and spatial patterns of town and rural settlements. Studies on the evolution of rural spatial patterns, by analyses of old cadastral surveys and maps, provide interesting results about the evolution of the Polish rural landscape (M. Kiełczewska-Zaleska 1956; M. Dobrowolska 1961; H. Szulc 1968; A. Prochownik 1965; J. Tkocz 1971). Studies on towns, whose complex historically determined patterns are scrutinized by historians and archeologists, attempt to provide the morphogenetic characteristics of contemporary spatial patterns (M. Koter 1969; S. Witkowski 1967).

This concise review of the research problems in settlement geography is intended to show the principal trends in this branch of the subject. Neither all of the very numerous studies in this field have been mentioned, nor all

their problems discussed. Only the general developmental trends have been presented and some examples of detailed studies noted.

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THE GEOGRAPHICAL DIFFERENTIATION OF CONTEMPORARY URBANIZATION

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In one of her recent lectures Maria Kiełczewska-Zaleska defined the task of a geographer as: first, defining the problem which is to become the object of research; second, identifying the processes of change which this problem undergoes with passage of time, and finally, forecasting its probable further development. In view of this statement my task is to define the concept of urbanization and its contemporary forms, to identify the mechanisms of change in the present characteristics of urbanization, and finally, to forecast its further development.

Let us take as our starting point the definitions adopted as a working hypothesis in the work of the Commission on Patterns and Processes of Urbanization of the International Geographical Union. Urbanization in this case is described as a social phenomenon, as the transformation of large communities (at present national or state communities) or their parts from a traditional rural society into more diversified urban one. Such a transformation involves changes in conditions and ways of life (although not necessarily including dwelling and working places). In these, urbanization differs from industrialization, which involves changes in the conditions and methods of production. Both these phenomena are mutually related and interdependent; nevertheless urbanization is above all a social phenomenon, while industrialization is mainly an economic one.

A definition of this kind is rather wide, perhaps too wide. However, it covers the fact that the phenomenon of urbanization is found in various forms and may be measured by various indices rather well. At the same time identification of the concepts of urbanization with specific social changes indicates that urbanization is essentially a social process which may, and in reality does, develop unevenly both in space and time.

In discussing the geographical differences in contemporary urbanization I want to concentrate on the Polish scene. Only at the end will I try to identify the similarities and differences with other countries.

The results of the last National Census (carried on from December 8, 1970) indicate that the percentages of urban population in the north-western voivodships are, generally speaking higher than in the south-eastern ones. In the former they are over 50% in the latter under 40% (in the voivodship of Rzeszów even under 30%). However, the variations in non-agricultural population show a somewhat different pattern. They show that such percentages in the southern voivodships are persistently higher than expected from the indices of urban population. The four southern voivodships of Katowice, Opole, Cracow and

Wrocław form an integrated region, where the index of non-agricultural population in the rural areas is clearly higher than 50%, with the adjoining voivodships of Zielona Góra and Rzeszów nearly reaching this level of 50% also. These data indicate the different character of urbanization in the south from the remaining parts of the country. Such a pattern becomes even more complicated when other additional indices, describing either the concentration of population, or the density of the settlement network (number of settlement units in relation to the area of the given region) or structure of a settlement network as expressed by the size of settlements. All these problems were described in detail by the author in a series of articles published over the last decade. They came out comparatively clearly on a synthetical map, which was first published in 1964[1] and subsequently reproduced several times. Their features have not changed very much since that time or at least this seems to be the case. Until the data of the last census is published and analysed in detail, this can not be fully checked and modified.

Some differences in the structure of settlement networks should be explained on the one hand by the conditions in the natural environment (such as variations in soil, extensive areas of forests and lakes and so on), and by the features of the historical development of settlements on the other. Such differences form only the framework and background for the phenomena of contemporary urbanization. However, there are other differences directly connected with urbanization. They may be defined as phenomena, firstly of local settlement complexes, formed directly from the integration of rural and industrial villages, plus small service towns, into medium sized functional settlement systems (or using the terminology developed by geographers of Wrocław University who described this phenomenon for the first time, the extent of "semi-urbanization"). Secondly, they may be defined as phenomena of large urban and industrial agglomerations, resulting either from the territorial expansion of a very large city (so-called metropolitan areas) or from the physical integration of originally disconnected, very often even random, industrial developments (so-called conurbations). The settlement complexes of this kind are based on spatial functionalization and integration of the everyday life of individuals and the community. The social and economic activities are enclosed here within one-day cycle. There is another parallel and simultaneous process of functionalization and integration of the whole settlement network taking place within the national economy, which is based on the social territorial division of labour over longer periods of time. As a result, a national settlement system develops in which the settlement complexes just mentioned form only local or regional subsystems.

To understand fully the character and role of these subsystems, a short analysis of the mechanisms of their emergence and development is required.

The phases in the development of local settlement complexes in Poland were described by A. Zagożdżon. Alongside the production links, as expressed in the commuting to work, he also stresses the linkages connected with trips from dwellings to the service centres. The growth of these complexes is obviously connected with the progress of industrialization, particularly with industrial plants located in smaller towns or even in rural settlements. There arises a question which cannot be satisfactorily answered at present; whether these local complexes will also develop because of new technologies in the agricultural production, as an expression of the increasing urbanization of rural population.

In Poland the local settlement complexes mostly developed in the southern

[1] In: K. Dziewoński, Urbanization in contemporary Poland, *Geogr. Pol.*, 3, Warszawa 1964, p. 51.

parts of the country, which were industrialized first and very intensively. These now have the highest percentages of non-agricultural population in rural areas. However, it is necessary to remember that research into the distribution and the development of local settlement complexes in only beginning, and that so far there are practically no comparative studies.

As already stated, large urban and industrial agglomerations develop in Poland in two ways: as metropolitan areas and industrial conurbations. The mechanisms of growth of a metropolitan area are well known, and differ very little from those in other countries. Here, as elsewhere, growth in first concentric, changing later to a radial one along the main exit roads. Then satellite cities develop either by the transformation of small service towns and industrial villages within the growing metropolis, or by the construction of completely new towns. The Polish geographer, P. Korcelli, recently presented an interesting conception of the wave-like growth of metropolitan areas, but he did not illustrate his model with Polish examples.

The successive phases in the development of an industrial conurbation are not yet well studied. Recently I proposed three basic phases. The early one has a growing density of industrial settlements and leads to the emergence of an intensively developed area, which may be defined as a conurbation, and is usually based on the exploitation of some specific local mineral resources. In the second one, through the process of spatial integration and rationalization, there emerges — the central city, and in the last one we have full maturity when the emerging local (or regional) community is able to substitute a different economic base for its existence, replacing the obsolescent one because of a depletion of local mineral resources or of revolutionary technological changes. This last phase is specially important as it proves the existence of a stabilized community, and at the same time forms the basis for the final development of a rational spatial structure of the conurbation, replacing the former haphazard one. It is interesting to note that in the final phases of development both types of large urban and industrial agglomerations tend to develop similar physical patterms. We have here another case of specific social entropy.

The number (and distribution) of large agglomerations in Poland varies from 9 to 18, according to the criteria used in their identification. Five of them form one very large region in the southern part of the country with strong tendencies to extend in westerly and easterly directions. Growth towards the north is also possible. Usually it is called the Industrial Region of Upper Silesia and Cracow. These problems are at present the object of very extensive studies, directed by S. Leszczycki.

The structure of the large urban and industrial agglomerations of Poland represent very large number of various forms. The most characteristic element is the degree of concentration of industrial plants and of population. The most diverse here are Łódź, representing the greatest concentration, and the so-called Old-Polish District (also called the Kamienna Valley or Holy Cross Mountain District) representing the most dispersed pattern. It should be noted that these agglomerations are quite near one to another.

Another structural element, partly related to the one already described, is the three zones; the core area (sometimes described as the central district, or for metropolitan areas, the city proper), plus the internal and external suburban zones (the internal zone may be identified with the suburbs proper, the external zone with the suburban zone). The differences are not only in the intensity of the use of land, density of population and buildings, but also in the functions, although these do tend to change in time. However, at present, the core area is characterized by a dominance of work places and services; the internal

suburban zone by extensive housing estates and large transport and storage facilities; and the external suburban zone by a mixed character of residential development and specific, highly intensive forms of agriculture. This three zone pattern is not equally developed in all agglomerations; it varies depending on the historical background of the given agglomeration, on its present size, and its present phase of growth.

The rate of growth of all agglomerations is illustrated by the data given later; they are approximations only. Various geographers and scientists give widely differing estimates, according to the criteria they use. The data presented here are according to the official statistics published on 1969. At present in Poland one third of the total population and one half of the total urban population live in agglomerations. By the end of the present century it is expected that more than half the total population and about two-thirds of the urban population will live in the agglomerations existing at that time. The ratio of this population to the total population in the country will then become the main index of the progress of urbanization. The urban population will by then have reached 75–80 percent of the total population, an index which will not subsequently alter very much.

Let us now return to the problem of the existence and development of the settlement system of the whole country. Generally speaking the geography of settlement in Polish lands through the ages can be presented as a process of integration and disintegration of the national settlement system. Limiting ourselves to the analysis of the inter- and post-war period, we may define the characteristic process as one of reintegration, which became particularly marked as a result of post-war migrations of population, and the industrialization of the country carried out within a socialist planned economy.

In commenting on the problems of a settlement system the following subjects must be discussed: (1) the identification of the system as opposed to the external world, implying a definition of its openning and its closure; (2) identification of its internal structure and of its subsystems; (3) delimitation of the system and its subsystems; (4) analysis of the cohesion of the system and its subsystems; (5) analysis of the stability and permanence of the system; and finally (6) identification of permanent changes taking place within the system, in particular of its growth.

Whenever we analyse a settlement system from the point of view of the geographical aspects of urbanization the discussion of the first subject has to include the place of Polish settlement system within the settlement systems of the socialist countries and of Europe. It is necessary to state here that so far this problem has neither been conceptually and methodically thought out nor analysed in any detail. Generally speaking, it is obvious that the development of interrelations between the countries of the Council for Mutual Economic Aid may, and should, lead to the specialization in production of these countries, which will undoubtedly in turn form the basis for the integration of their settlement system. However, to start with, the rate of such integration will tend to be slow. Mutual linkages may be both spatially direct and indirect. To date, in the spatial patterns of settlement systems, the only examples of direct linkages may be observed on the Polish and Czechoslovak frontier, between the industrial coal basins of Ostrava and Upper Silesia (in particular of Rybnik), between the National Parks in the Tatra Mountains and along the Polish, German, and Czechoslovak frontiers in the region of Turoszów and Zgorzelec. We have here examples of interrelations between large neighbouring urban and industrial agglomerations, of tourist and recreational settlement complexes, as well as smaller industrial districts.

The main points of entrance and exit into the system are very important elements in the settlement system. They are the main transport nodes and are particularly important where there is a break or change in the transport means. This is the case with sea-ports (Gdańsk-Gdynia and Szczecin-Świnoujście) or of railroad terminals which are connected with a change of the gauge of the tracts (mainly Medyka, but also Chełm, Terespol and Sokółka).

The role played by the Polish settlement system in Europe is even more difficult to define. There are some well-known concepts which interpret the settlement pattern of the entire continent in terms of Thünen's rings, starting from the centre covering the Ruhr region, the Benelux countries and South-Eastern England. According to these concepts, Poland would lie within the outer suburban zone. Such concept soon turns out to be sterile when the economic and population potential of the European part of the Soviet Union, and the industrial and urban progress achieved in Poland itself, are taken into account. Moreover, the Upper Silesian and Cracow industrial region (together with the Ostrava industrial district) represents, after the Ruhr, the largest concentration of mining and heavy industry in Europe. Equally invalid are the old German concepts of Central Europe (*Mitteleuropa*), especially if we remember their geopolitical background.

The most realistic concept seems to be that which describes Poland and her settlement network as an important link — along with the German Democratic Republic — in the exchanges and relations between the republics of the Soviet Union and the industrialized countries of North-Western Europe. This is a similar role to that played by Czechoslovakia and Hungary in relations between the Soviet Union and South-Western Europe, or by Rumania and Bulgaria in relation to Southern Europe. The position of Poland as an intermediary between the Scandinavian countries in the North and the Danubian countries in the South is not equally important because of the weaker economic relations existing at present.

The identification of the internal structure of the Polish settlement system is easier when we consider our introductory remarks about some of the settlement subsystems. We have already discussed two types of subsystems; local settlement complexes and large urban and industrial agglomerations, and commented on their distribution and growth. The existence of other possible subsystems and the role played by all subsystems, remains to be explained.

The introduction of subsystems in the analysis of a settlement system is a methodological necessity in view of the complexity of the problems and the number of settlement units involved. At the same time it is evident that these subsystems should correspond as far as possible with natural groupings of settlements in reality; they should fit the regional structural divisions of the whole country. It is therefore necessary to indicate how far the subsystems we have described earlier are regional in character. Are the local settlement complexes grouped together in regional entities? Is it possible to identify the large urban and industrial agglomeration with specific regional settlement subsystems? These questions may be put in a different way; that is whether within the settlement system of Poland there exists a specific hierarchical pattern of settlements — settlements which according to the well-known theory could be described as a system of central places. From research carried out so far it is possible to state that most cities, towns and settlements in Poland possess some definite central functions. However, a clearly defined and integrated hierarchical structure is evident only in those functions which are directly connected with the administration and territorial organization of political and social life.

Economic life is only partly organized on the basis of spatial criteria; it mainly depends on organization by sectors and branches. It is clear by now that the basic activities, so far as the production is concerned, are increasingly carried out on the national or even supranational level.

From the preceding remarks we can assume that one can introduce a subdivision of the whole settlement system, by voivodships i.e. by the administrative regional units. However, a new question now arises; to what extent do these division correspond to the natural subsystems already defined and identified.

The research carried out under the direction of R. Domański on the spatial structure of the Konin industrial district has shown that, although the administrative boundaries of a voivodship do reduce commuting to work to the one third of its potential size, they do not eliminate such commuting entirely. Hence the question whether the boundaries of a voivodship and of local settlement complexes coincide or not, has to be individually considered for each case. The problem is easier, however, for the large agglomerations. With the exception of the Upper Silesian and Cracow region all other agglomerations are situated completely within the one or an other voivodship. In addition, this region contains several agglomerations which are not only situated, and grow across the voivodship boundaries, but are becoming integrated into a supra-voivodship regional complex.

Obviously the capital city is at the top of the hierarchical pattern of settlements. Nevertheless, Poland's capital does not have a very high concentration of economic, social and cultural life. This is a result of the historical processes of recent centuries. It is possible to discuss the problems of the settlement system in Poland in terms of a polycentric pattern, and even to speak of the distribution of some of central functions between various agglomerations. This problem is well illustrated by the location of scientific centres and the distribution of scientific cadres within the whole country (in 1966 Warsaw had 60%, Cracow 12%, Wrocław 9%, Poznań 6% and Katowice 3%).

The problem of the boundaries of the present settlement system is simple; they correspond to state boundaries. The regional subsystems, being at least partly identified with the voivodships, similarly correspond to the voivodship boundaries. In future the complete identification of the large urban and industrial agglomerations with the voivodships, may be more easily made as a result of their growth and of the steadily growing technological revolution in transport (expressed at present mainly by the spread of private car ownership).

The question of the cohesion of the settlement system and subsystems has not yet been looked into. The basic difficulty here is the necessity of quantitative measurement, and the scarcity of the necessary statistical data.

A similar situation arises when we move to the problems of the stability and permanence of the system, although in this field we can recognize some phenomena indicating a great immobility in the existing settlement networks. The individual points and nodes in such a network show strong resistance to more radical changes in their functions, both by defending their previous structures and by the ability to form and adapt some substitute functions. All changes involved, although sometimes important on local scale (for instance, the growth of a new town or strong growth of an old one), are becoming significant on the regional or national scale only very slowly.

However, some changes within the whole system do take place. There are currently two trends. On the one hand there is a constantly growing integration of the system; the nationally specialized functions are more important for the growth of cities and settlements than the central functions. On the other hand are the phenomena of social and economic entropy. The cities, especially the

larger ones, tend to become multifunctional; the greater differences in the urban equipment, technical infrastructure and the living conditions tend to diminish and slowly disappear.

Perspectives on further changes in the structure of settlement subsystems are now becoming clearer. It seems that the basic trend is towards a network of urban regions evolving out of the present urban and industrial agglomerations. What is less clear is their further integration in the supra-regional scale. Two trends are possible: a partial integration, similar to one taking place in the Upper Silesian and Cracow Industrial Region; or a full integration, transforming the total area of Poland, its whole settlement system into one huge "megalopolis". Some writers limit its future extent to a triangle, delimited by Wrocław, Gdańsk and Przemyśl, leaving the north-western and north-eastern regions outside this continuous and intensive urban zone. However, such a pattern would be nothing but a phase in the process of constantly growing industrialization and urbanization.

One problem remains to be clarified — how to characterize the state and development perspective of the Polish settlement system in comparison to the state and that development perspectives of other countries. So far we have discussed this question only from the point of view of relations between the Polish system and systems of both the socialist countries and the European countries. However, to fully answer the question now raised we lack full statistical information. As a result the following comments are nothing more than an introductory working hypothesis.

For comparison let us remember the basic characteristics of Polish urbanization and of the Polish settlement system. The country is going through a period of very rapid industrialization and urbanization. The percentage of urban population, which in the interwar period fluctuated around 30, is now slightly over 50, and at the end of the century will probably be between 70 and 80. In addition, the settlement system, and in particular the urban system, is highly integrated, polycentric, and without a strong hierarchical structure. In the pattern of settlement subsystems the large urban and industrial agglomerations are already playing the main role; this is constantly increasing. The network of central places fullfils a more important role only at the regional and local level, and mainly outside these agglomerations. At the same time the functionalization and specialization of settlements is becoming more and more evident.

On the basis of data published by the United Nations in 1920 the percentage of urban population in the world was 20; in 1960 it was 32. A projection for the year 2000 gives a figure of 50%. In Europe the corresponding data were about 47, 59 and 70; in the Soviet Union about 17, 50 and 85; in South and North America 22–52, 50–70 and 80–88; in Africa and Asia 8–10, 18–23 and 35–40.

The urbanization of Poland is therefore below the average for Europe but much above the world average. Of the socialist countries, Polands indices are lower than those of the German Democratic Republic and Czechoslovakia, but higher than those of the remaining countries. Direct comparison with the Soviet Union is difficult because of the differences in scale of both countries. It is possible, however, to state that the Polish indices are higher then those of the federal republics of the Ukraine. Byelorussia and Lithuania, and lower than those of Estonia and Latvia. Therefore, although Poland does not belong to the class of countries which are most highly urbanized, nevertheless it is already in the class of highly urbanized ones. It is a country which is undergoing strong urbanization as a result of socialist industrialization. At the end of the present century it will be one of those countries with the highest index of urbanization.

The integration of the settlement system is very advanced in Poland, perhaps

more than in other countries. This is a result of historical development, war devastations and changes, post-war migrations, and the transformation of the social structure carried out within the framework of a socialist economy. For comparison, we can take Great Britain and Czechoslovakia. In the former, the process of integration has a different character, being dominated by the enormous growth of the London agglomeration; in the latter the same process is limited by the geographical environment and by a very clear division of the whole state into two widely different social and economic regions.

The problems of integration are closely connected with the polycentric structure of the settlement network. It is interesting to note that in the analysis on the primacy of the largest city (as measured by the relation between the number of inhabitants of the largest city and the total number of inhabitants of the four largest cities) carried out in 1960 by N. Ginsburg, Poland was fifth among the countries with the smallest primacies. Among the European countries in the same class there were only Italy, Spain and Yugoslavia. However, all these countries are noted for the heterogenic distribution of their socio-economic structure, which would imply a rather low integration of the settlement system. The Polish system is therefore characterized by integration and polycentrism. It should be added that the other European socialist countries generally have much higher indices of the primacy of the capital city (the main urban and industrial agglomeration). Ginsburg calculated, that starting from the bottom, the German Democratic Republic is 38th, the Soviet Union 43rd, Czechoslovakia 48th, Bulgaria 66th, Rumania 88th and Hungary 102nd (Poland 5th). In the preceding remarks I have advanced the thesis of the weak hierarchy of the Polish settlement system. This is supported by the research studies which show that the existing elements of such a hierarchy are all closely connected with the territorial administrative and organization activities. In Western literature we possess an enormous number of publications dealing with hierarchical structures. They identify a large number of hierarchical levels. They can usually point to more than seven, sometimes more than nine, while in Poland it is difficult to recognize more than four. Where does the difference lie? I think it depends to a very large extent on a bias in research, on the lack of quantitative measurements of the significance of hierarchical elements compared with those specialized in production and service elements. In addition, some statistical regularities, depending on and developing out of specific probabilities, are too often identified as clearly deterministic. For these reasons I think the hierarchical relations and structures are less diversified and less developed than is usually assumed. In my opinion further research on these matters is necessary. Publications and studies on the large urban and industrial agglomerations are numerous. Nevertheless, omitting the reports concerned with their planning, the problems of their growth and structure in socialist countries are not really well known. The planning studies are based as a rule on some very arbitrary assumptions; only rarely do they make use of precise and detailed knowledge of reality. However, the themes which should be classified, although interesting, are very complex. They involve economic, sociological, historical and geographical methods of analysis. Let us take an example; it is well known that there are two types of development of large agglomerations under capitalist conditions. First, the poor migrate from rural areas to the centre of a city, where they occupy old buildings with insufficient and antiquated provisions, while the richer inhabitants move from the centre to the new peripheral districts. This type is characteristic of the developed countries with a large amount of inherited fixed assets (buildings). The second type may be found in new sparsely settled countries as well as in the developing ones. It is marked by

a great concentration of dwellings of the rich in the centre of a city. Here, the suburbs are occupied by buildings which, although they are new, are evidently also substandard. Here the poor, with no profession or skill, settle down as migrants from rural areas. We realize that the structure of a socialist city has to be classless, but we do not know whether the processes of urban growth, of population influx from the outside world, have a specific spatial pattern.

In Poland agglomerations grow up through the construction of new housing estates and residential districts, fully equipped with modern sanitary and communal conditions. These are occupied by people which have recently moved to these agglomerations from rural areas. In the beginning these housing estates were located in the central districts on lots, where the old buildings were destroyed by the war. Now, however, it becomes more and more necessary to find new locations. At the same time, especially in the Upper Silesian Industrial District (so-called GOP) a serious effort is beging made to transform and renew the traditional shopping and office centres of the main cities. In addition, especially in the late sixties, cooperative and private housing developed in the peripheries of large agglomerations. These buildings are only partly equipped according to accepted standards and in most cases this is haphazardously controlled. At the same time the conservation of old buildings becomes more and more necessary. In contrast with capitalist countries the influx from the rural areas is directed towards the new dwellings, which are technically fully equipped. A physical plan of development decides the spatial pattern choice of locations and the directions of growth. Hence, in spite of some serious mistakes, the growth of agglomerations is more balanced and rational. This phenomenon is, in my opinion, characteristic of all socialist countries.

In the large agglomerations of capitalist countries two additional phenomena have recently emerged: a slowing down in the growth of the largest agglomerations in comparison with the smaller ones, and a depopulation of the central districts (core areas), and sometimes even of the internal suburban zone. These phenomena may be observed, for instance, in London and its environs. The first phenomenon may be seen also in Poland; however the second one is evident only on a very moderate scale, in Upper Silesia. Both may be interpreted as signs of either social entropy, or of a wave-like growth of the metropolitan areas. Assuming the latter to be correct, the situation in Poland may be interpreted as either the first phase in the growth of large urban agglomerations, or as a new wave of growth triggered off by the modernization and transformation of the core areas after the war devastation.

Problems connected with the network of cities and towns having central functions in Poland, have some similarities with such networks in other European countries. All these networks evolved during the 18th and 19th centuries out of feudal settlements formed in the Middle Ages. At the same time the fact that the Polish cities and settlements in this formative period were under the influence of three different policies exercised by the occupying powers, created an unusual mosaic of regional network types. Finally, one must not forget that the processes of integration of the whole settlement system, together with functionalization and specialization of various cities and settlements, has been going on for over fifty years. But we do not possess sufficient information to say whether the same processes in other countries of Central Europe develop in the same way, or whether they lead to a pronounced variations in the settlement system.

The last question to be discussed is one which cannot be omitted in a geographical analysis; how and to what extent are both the elements of the geographical environment and the environment as a whole reflected in the develop-

ment of the urbanization processes and in the settlement system. In Polish conditions the elements with the strongest influence are those which possess and create specific productive opportunities, such as soils, mineral deposits, large forest complexes and water resources. The latter are becoming increasingly important, especially for the development of cities and industries. However, main changes in the physical pattern of the settlement system in the last twenty five years have been connected with the exploitation of new deposits of sulphur, copper, and lignite. On the other hand the growth of various media of mass transport and the lowering of their cost (in relation both to other costs and to the advantages of production concentration) reduces the advantage of locating processing industries close to mineral deposits or water resources in a country of Poland's size.

The negative influence of the geographical environment on the development of urbanization was, and is still, not very distinctive, because the Polish lands are in about 90% plains, there are no regions of notable seismic activity, and the climate is moderate with only weak internal variations. In all these aspects Poland is not a very diversified country especially when her comparatively large size is taken into account. This is without any doubt one of the most important factors making the strong integration of her settlement system possible. As a result it would appear that the direct influence of the natural conditions on the development of the Polish settlement system is much smaller than in other countries, even her direct neighbours, which develop under similar economic, social and political conditions.

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THE CONCEPT OF A UNIFIED SETTLEMENT SYSTEM AND THE PLANNED CONTROL OF THE GROWTH OF TOWNS IN THE USSR

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The purpose of the present study is to present a general concept of the development of settlement[1] in the USSR, and through this to work out the basic policy assumptions for controlling the growth of towns and other settlements. Without this concept it would be difficult to carry out rational regional and urban planning. The concept of settlement development should, on the one hand, have a theoretical basis, and on the other, be based on an analysis of the empirical trends in modern settlement networks.

Theoretically, the Marxist thesis about eroding the differences between town and country during the building of communism, is very important.

The division of settlement types into urban and rural results from the social and territorial division of labour, and particularly from the separation of industry and agriculture.

This division went hand in hand with the class differentiation of society. "The division of labour in any society leads above all to the separation of labour in industry and trade from that in agriculture, and similarly to the separation of town and country".[2] In a class society this division creates an antagonism between town and country. With the liquidation of the class structure, and with the rebuilding of society along communist lines, the existing differences between town and country will gradually be eroded. However, certain features of agricultural production and its related form of settlement will remain, distinguishing this from other branches of the national economy, above all from large scale industry and its related forms of settlement.

The important points about long-term changes in the growth of towns is that the erosion of the differences between town and country will lead to a *unified system of settlement*; the planned control of this system may avert the lively and uncontrolled growth of towns. In a bourgeois society the town governs the country. According to Engels the elimination of the old division of labour in a classless society, will signify "the fusion of town and country".[3]

[1] The term *rasseleniye naseleniya* in our literature can refer to both the process of the distribution of population over an area and to the result of this process (the settlement network). Such a wide term has no equivalent as far as we know, in English. In Polish literature, the term *rasseleniye* meaning a settlement network, is *osadnictwo* (one can correspondingly distinguish the term *geografia osadnictwa* — *geografiya rasseleniya* in Russian — see for example M. Kiełczewska-Zaleska, *Geografia osadnictwa* (Settlement geography), Warszawa 1969.

[2] K. Marks, F. Engels, *Sochineniya* (Works), 2nd ed., vol. 3, p. 20.

[3] K. Marks, F. Engels, *Sochineniya* (Works), 2nd, ed., vol. 20, p. 308.

This does not mean the absorption of the country by the town, as some urbanists hold, but the fussion of these two forms within the unified system of settlement. In the country man is usually subject to nature, but in the town he is unnaturally cut off from it; in the future unified system of settlement man will be in harmony with nature.

Engels' thesis about the liquidation of the differences, and the subsequent merging of town and country, is sometimes taken to be a distant goal, removed from our time. One often hears that Engels' remarks on this question were accidental. Both these views are completely erroneous. In his work "The Question of Housing", and particularly in "Anti-Dühring" he not only puts forward, but also justifies his thesis about eroding the boundaries between town and country. The justification of his thesis is all the more remarkable in that it takes up economic, sociological and ecological standpoints all at the same time. At the same time it is connected with the urgent tasks of social development. From the economic standpoint "liquidating the antagonism between town and country is not only possible, but it becomes a necessity for both industrial and agricultural production".[4] "The prospect of eliminating the old division of labour stands before us" Engels emphasised, "this and the division between town and country".[5] From the sociological standpoint, the task of eliminating the antagonism between town and country is justified by Engels by the necessity "of plucking the agricultural population from its isolation and dullness in which it has vegetated for thousands of years",[6] i.e., the life-style of the rural population can now actually be called "urban". From the ecological standpoint the elimination of the antagonism is, according to Engels, "necessary in the interests of social hygiene. Only by merging town and country can the present poisoning of air, water and soil, be eliminated".[7]

The works of Marxism-Leninism classics not only justify the necessity of eliminating the antagonism between town and country and their subsequent fusion, but they also outline how this can be achieved: (1) the harmonious development of productive forces according to a single overall plan; (2) a greater equalization of the distribution of large-scale industry and of the population over the country; (3) achieving strong internal links between industrial and agricultural production; (4) the development of communications; (5) overcoming the excessive concentration of population in large cities (as the capitalist means of production is eliminated). Socialism will lead to "a new settlement pattern of mankind (with the elimination of both rural neglect, isolation from the world, its barbarism, and of the unnatural concentration of huge populations in the large towns)".[8] The need "to strive with every effort ... for the rational distribution of workers" was expressed in the Party Programme, accepted at the 8th Congress of the RKP(b), and worked out on V. I. Lenin's directives.[9] An important methodological recommendation of V. I. Lenin's is "the unconstrained distribution of population throughout Russia" connected with "the rational economic use of the outlying areas of Russia".[10]

In directing these theoretical legacies, the party does a lot of the work

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[4] F. Engels, Anti-Dühring, in: K. Marks, F. Engels, *Sochineniya* (Works), 2nd ed., vol. 20, pp. 307–308.

[5] Ibid., p. 308.

[6] F. Engels, K zhilishchnomu voprosu (On the housing question), in: K. Marks, F. Engels, *Sochineniya* (Works), 2nd ed., vol. 18, p. 277.

[7] F. Engels, Anti-Dühring, in: op. cit., p. 308.

[8] V. I. Lenin, *Poln. sobr. soch.* (Complete works), 5th ed., vol. 26, p. 74.

[9] *Programma RKP(b)* (Programme of RKP(b)). V. I. Lenin, ibid., vol. 38, p. 443.

[10] Ibid., vol. 16, p. 227.

through the rational and planned development of the economies and cultures of the peoples of the Soviet Union, through locating production and distributing settlements throughout the country. The question of rational settlement is referred to in the Programme of the CPSU, accepted by the 22nd Party Congress: "The developed building of Communism requires an even more rational distribution of industry which will ensure an economy in social endeavour, the integrated development of regions and specialization of their economy, will eliminate excessive concentration of population in large towns, will help overcome the existing differences between town and country, and will make the level of economic development of regions more equal".[11]

These propositions are of prime importance for working out the scientific concept of the distribution of population.

Socialism was the first system to assume an end to the antagonism between classes, opening the era of the classless society, and predetermining the possible liquidation of the conflict between town and country. The formation of a single communist ownership, the linking of agricultural labour with industrial, and the transformation of the former into a variant of the latter, the establishment of the social equality of urban and rural workers these are the socio-economic pre-conditions for eliminating the differences between town and country. In our country the general socio-economic process of eroding the boundaries between town and country is found in many phenomena, including: the mechanization and industrialization of agriculture (the change to a greater industrialization of the livestock branch of agriculture in recent years has been particularly important in the current plan); the spread of agro-industrial combines; the growth of "urban" occupations in the village, and as a result of this the increasing homogeneity of urban and rural workers; the growing local movement of population and increasing journey to work between village and town; making the flows of information more equal; spreading the network of developed urban centres so as to draw the large rural population into its economic and social orbit; making the small towns more active, and so on.

In this connection we must turn our attention to certain principal changes in the development and distribution of the forces of production in our country, which are important for solving the problems of settlement.

(1) It is well known that in the USSR there is an increasing number of large towns. In recent decades particularly, an important aspect of this process has appeared. This is that the development of a network of large towns proceeds according to the principle of an "expanding geography of productional forces", helping the economic activations of formerly backward regions. The importance of large towns in the population structure of the country is gradually decreasing. Thus the proportion of the population of the seven "old" million-cities — Moscow, Leningrad, Kiev, Tashkent, Baku, Kharkov and Gorki — in the total population of large towns has changed during the Soviet period, from 60% in 1926, to 40.7% in 1939, 29.4% in 1959, and 23.4% in 1970.

(2) In recent decades there has been a significant increase in the urbanization of formerly backward developed *oblasts* and republics of the country. This is well seen in the data of the 1959 and 1970 population censuses. The higher growth rates of the total urban population in usually found in those *oblasts* with a low proportion of urban population, which testifies to an intensive "pulling-up" process of the urban network to a higher level in previously backward *oblasts*. There are now hardly any weakly-urbanized *oblasts* with a low

[11] *Programma Kommunisticheskoy Partii Sovetskogo Soyuza* (The Programme of the Communist Party of the Soviet Union), Moskva 1969, p. 72

rate of urbanization. The urban population rose by 36% from 1959 to 1970, and the proportion of urban population reached 56%. Out of 138 *krays, oblasts,* Autonomous Republics, and Union Republics which have no *oblast* divisions, the proportion of urban population exceeded 55% in 49 (we will call this the first group). It was between 50 and 55% in 13 (the second group), and less than 50% in 76 (third group). Lower than average rates of growth took up 65.3% of the administrative-territorial units in the first group, 38.5% in the second, and only 18.4% in the third.

The current growth of large towns testifies to a more equal distribution of the forces of production over the country. It does not testify, as some economists who limit themselves to a superficial look at the process of the concentration of population in large towns, believe, to a deepening of an inherited "inequality" of development.

(3) In recent years, and particularly in the 1966–1970 five year period there have been fundamental changes in the distribution of industry. These have come about through the establishment and construction of branches and separate sections of large industrial enterprises in developed industrial centres of the country in many peripheral towns (of both small and medium size). This phenomenon was a small scale one before 1966, but during the period 1966–1970 become a very large-scale one. Branches sprang up not only in towns and villages near Moscow, Kiev, Riga and other cities, but also in far-off regions of the European part of the country. For example in the Mari A.S.S.R. there are branches of head factories in Yoshkar-Ol, Kazan and even in Leningrad, Kharkov and Kuznetsk (Penzen *Oblast*). Two branches were located in such towns as Volzhsk and Kosmodemyansk, and one in the worker settlements of Krasnogorskiy and Morki. This phenomenon represents a serious step forward in solving the so-called "problem of small towns", which possess free labour resources, but do not have the level of technology for modern industrial production. It is to these factories which do have the required technology that young people go with their high hopes after finishing middle school. Having come up against a labour deficit in the large towns and the difficulty of attracting supplementary labour from elsewhere, industry (especially the labour-intensive machine building industry) goes to the labour reserves in outlying areas. Thus the branches of such factories as the Moscow ZIL were located in a series of towns in many *oblasts* in the European part of the USRR.

(4) The practice of organizing separate scientific-research and project institutes in small towns, whose main branches are usually located in large towns is becoming more frequent; those in the small towns have different productional objectives. There are also those towns whose development entirely depends on the establishment of scientific-productional complexes in them. This is a very important trend in the current scientific-technological revolution.

(5) In recent years in the USSR, as in other countries of the world, there has been a great increase in the mechanization and industrialization of the livestock branch of agriculture (through the construction of large livestock complexes and poultry farms — instead of the previously small-scale dairy farming — pig farms and so on). The collectivization of agriculture in its time led to crop mechanization and helped to solve the grain quality problem. The current changes can be seen as the second very important step forward, which along with an increasing use of chemicals and other processes, testify to an important spread of the technological revolution in our agriculture. This very important qualitative change will greatly influence the distribution both of basic capital in agriculture and of the rural population.

(6) Since 1950 there have been significant qualitative changes in the local

mobility of population (inter-village labour movements and cultural-everyday life links in different, regional settlement systems). These changes result particularly from the great effort put into developing sub-urban and inter-urban transport, especially bus transport. Whereas in 1950 51.9 million passengers used the inter-urban bus routes, in 1960 there were 551.3 millions, and by 1968 this figure had doubled.[12] These seemingly trivial indices of the development of inter-urban communication (the increasing number and distances of bus routes, and of passenger movement, etc.), in fact hide great progress in the general life-style of the population, particularly, that of the rural population. The wide development of bus communication and local aeroplane services in a short time changed the life-style of many rural areas, clearly increasing the mobility of the rural population and linking it with the town, and breaking with the concept of the "deep province". An increase in the scale of commuting to work is connected with this. This commuting is made up of inter-settlement labour links from village to town. At present this process involves 3 million people throughout the USSR.[13]

(7) The wide development of channels of information and communication also help to change the style of life of people in outlying regions, and bring it closer to that of the capital cities.

These important changes are already greatly influencing (and this will increase still more in the future) all aspects of the process of the development and distribution of productional forces in our country. They are undoubtedly helping to make this distribution and development more equal, and are eroding the boundaries between town and country.

In looking at the historical aspect of the question of the development of the forces of production and social relations, one can distinguish two basic trends which strongly affect the process of settlement. An increasing territorial division of labour and differentiation of the distribution of the products of this labour result in a concentration of industrial production and urban population. This can be seen in the rapid growth of large towns. Revolutionary changes in management, in the techniques of distribution and exchange, and in inter-settlement links lead to the establishment of a unified settlement system. Its basic features are: first, a freer distribution of population over wide areas which form communities of interests and are characterized by intensive interrelations rather than intensive forms of urban development. Second, there is a more equal distribution of production and population throughout the country. Its is possible to glimpse the outline of the future "unified settlement system" in the regulation and combination of the various types of settlement distribution. In the trend towards an increasing radius of large-scale settlement of workers in places which act as supplementary sources of labour and development of commuting due to the increasing speed of transport, one can see the future map of the world.

On this map settlement will not have to depend on the distance to places of supplementary labour.

It is necessary to have a general concept of the development of settlement particularly for working out the long-term control of the development of the forces of production and of the process of urbanization. Such studies are traditional in our country (one should especially mention N. Milyutin's work in the

[12] Narodnoye Khozyaystvo SSSR v 1969 (Soviet national economy in 1969), *Stat. yezhegodnik*, Moskva 1970.

[13] B. S. Khorev, T. K. Smolina, A. G. Vishnevskiy, Mayatnikovaya migratsiya v SSSR i ee izuchenye (Commuting in the USSR and its study), in: *Problemy migratsii naseleniya i trudovykh resursov*, Moskva 1970.

late 1920's on several important theses).[14] In recent years interest in the long term settlement problems has grown considerably. This is partly due to the preparation of a general scheme for the distribution of productional forces in the USSR up to 1980 under the direction of the all-Union Gosplan. Thus we have the task of scientifically working out a general scheme of settlement over the USSR, for the Economic Regions and Union Republics up to 1980.[15] The scientific sub-departments of the all-Union Gosstroi are working out forecasts for the development of Soviet urban growth for even longer periods (a special conference in February 1970 in Moscow was given over to this problem).[16] Because of the need to work out the long term distribution of population, Soviet geographers and urbanists have done a lot of work, especially, in the last ten years, on questions of group and agglomeration settlement distribution and on analysing territorial systems of settlement (notably the work V. G. Davidovich and his followers). At present we can already speak about a definite concept of the long-term distribution. However, it still needs a theoretical foundation (from the standpoints of urban science, sociology, economics and geography). We will call this the concept of a unified settlement system (*jedinnoi sistemy rasseleniya*), abbreviated to JSR. In general, this term is taken to mean the functionally differentiated and structurally interlinked network of all the settlements in a given large area. The network is established through several subordinate stages and is being evenly developed and controlled through planning for society as a whole, and is part of a unified system of regional planning.[17] The essence of the concept is that in the long term, through the regional distribution of the forces of production of separate regions, the historically formed settlement pattern (both its concentrated and dispersed forms) will be transformed into integrated regional systems of settlement units which are socially and economically interlinked; their size will depend on local conditions. These units will together form the unified (economic) system of settlement.[18]

The political aim in establishing the JSR is to secure the necessary comparable conditions of work and style of life for all the components of the system.[19] This does not mean, however, that the conditions of settlement in an existing small town will become like those in a large town. Within the system the very structure of settlement distribution must change significantly.

There are several types of permanent inter-settlement links which have

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[14] N. Milyutin, *Sotsgorod*, Moskva 1930.

[15] D. G. Khodzhaev, Nekotoriye problemy regulirovaniya rosta gorodov i razvitiya naselennykh mest (Some problems of controlling urban growth and development of urban settlements), *Problemy gradostroitelstva* 1, Kiev 1970.

[16] Perspektivy razvitya sovetskogo gradostroitelstva (On the perspectives of the development of Soviet town planning), *Arkhitektura SSSR*, 6, 1970.

[17] B. S. Khorev, Rasseleniye naseleniya: kriterii i kontseptsii (Population distribution: criteria and concepts), in: *Materialy Vsesoyuznoi nauchnoi konferentsii po problemam narodnonaseleniya Zakavkazya*, Erevan 1968; Rasseleniye i territorialno-sistemnaya organizatsiya proizvoditelnykh sil (The distribution and the territorial-system organization of productive forces), *AN SSSR, ser. geogr.*, 2, 1971.

[18] N. Baranov, Problemy perspektivnogo razvitiya sovetskogo gradostroitelstva (Problems of the perspective development of Soviet town planning), *Arkhitektura SSSR*, 4, 1970; Articles by N. A. Solofnenko, S. I. Soldatov, V. S. Ryazan, G. A. Kaplan and others, in: *Nauchniye prognozy razvitiya i formirovaniya sovetskikh gorodov na baze sotsialnogo i nauchno-tekhnicheskogo progressa* (Scientific predictions concerning the development and the forming of Soviet towns on the basis of social and scientific-technical progress), 3, Moskva 1969.

[19] The reason why the necessary living and working conditions are described as comparable is due to differences in the natural environment, so that it is impossible to achieve complete equality.

a great influence on the structure of settlement distribution: (1) productional, (2) cultural and everyday-life, (3) labour, (4) recreational and (5) informational. The development of these various types of link proceeds unevenly in time and space. This is the reason for the difference in the level of development and structure of settlement systems. The intensive development of the different types of inter-settlement links leads to the transformation of existing towns into agglomerations and "settlement region". These can be taken as new units of territorial and urban planning with their own peculiar internal structure. Z. N. Yargina has demonstrated one of the possible lines this transformations may take.[20] As a practical example of solving the internal structure of the JSR we can take the work of Lithuanian seientists and planners on a scheme for regional planning in their republic (the main ideas in this work can be found in the doctoral dissertation of K. Sheshelgis, "A uniform system of settlement in Lithuanian SSR", 1967).

Under the concept of the JSR the importance of separate urbanizing factors on the development of a given settlement is altered. Industry is no longer the basic and mandatory factor in each settlement. Learning, internal transport, a zone of recreation, and even a complex of institutions maintaining the important inter-urban services, can all act as an urbanizing base for the various types of settlement within the system. A change in the role of the separate factors in the whole system naturally changes the normative importance of their combined influence in calculations on the total population of particular towns. Such calculations must be carried out above all for the system (region) as a whole. Even in the near future the basic "urbanizing" or "town-forming" factors must be examined in the wider regional aspect as "region-forming" factors. We entirely agree with the well-known Polish urbanist K. Dziewoński, when he writes that with an increasing mobility of the population, of goods and information, and with the growing area of the towns, potential fields of urbanization arise. As a result the "opening-up" of a town increases, and the urbanizing base increasingly assumes functions which are not limited to a defined area.[21] This important theoretical observation can be found in Goryński's concept of a "regional-urban model".[22]

The formation of the JSR represents a new stage in the development of settlement, and also a step forward compared with the universally observed expansion of uncoordinated settlement forms of local combinations of settlements including large-town agglomerations. The nature of the emergence of agglomerations and the JSR is the same — the intensification of inter-settlement links. But there is an essential difference between them. A well organized and regulated agglomeration can be one of the components of the JSR, but the system as a whole represents a higher stage in the development of inter-settlement links. The JSR presupposes a certain intensity of these links (given a suitable technical standard to these links) and a certain level in the network

[20] Z. N. Yargina, *Sotsialniy progress i nekotoriye voprosy perspektivnogo rasseleniya* (doklad na VII Mezhdunarodnom sotsiologicheskom kongresse, Varna 1970) (Social progress and some questions on the perspective settlement network. Paper presented to the VIIth International Sociological Congress, Varna 1970), Moskva 1970.

[21] K. Dziewoński, The concept of the urban economic base: overlooked aspects, *Reg. Sci. Ass. Papers*, 18, 1967; Present needs and new developments in urban theory, 21st Intern. Geogr. Congress, India 1968, *Abstracts of Papers*, Calcutta 1968.

[22] J. Goryński, Problemy gradostroitelstwa v svete sovremennoi urbanizatsii (The nature and character of the urbanization process), *Trudy Kom. po delam Territ.-Ekonom. Razvitiya Strany PAN*, 16, Warszawa 1967 (in English: Studies, Committee for Space Economy and Regional Planning of the Polish Academy of Sciences, 19, Warszawa 1968).

of services, which will ensure comparable opportunities for using all the services and places of recreation by all the inhabitants of the regional system. In the Soviet Union, especially in the older developed regions this means that as well as improving the transport one should also create appropriate networks of focal centres of population in which various service institutions would be concentrated. Their distribution should ensure that they will be equally accessible to the whole population. The large urban agglomeration with its centripetal tendencies can be distinguished from the JSR by the way it divides the adjoining areas into those privileged nuclei with services and the remaining outlying areas without services. Under the JSR this division is overcome and the conditions for a "more equal distribution" of productional forces are created, as advised by Engels. However, it is often mistaken for the process of deconcentration of these forces, and thereby contrasted with the "law of concentration".

Two basic types of settlement network formation can be distinguished, occurring in the process of concentration of population itself (and in the concentration of the forces of production in general):

(A) Concentration in the chief, often excessively developed, centre, or in the chief town and its satellites. Example: the concentration in a country's capital or in the administrative centre of a region (or in a corresponding agglomeration) under the slackening development of "residual" settlement networks.

(B) Concentration in both the chief centre and several additional centres. Example: concentration proceeds in a country not only in its capital or in its 2 or 3 chief towns if it is a large country, but in all its large towns — the regional centres; or concentration proceeds in a region not only in its central towns but in several additional centres of average size.[23]

We think that type B can be the policy basis of the formation of the JSR in most older-developed regions of the USSR. In the European part of the country the development of settlement, according to this line, can lead, as Z. N. Yargina correctly pointed out, to the formation in the next 50–100 years of equal living conditions over the whole territory from the point of view of accessibility to centres of social activity. Only under these conditions can the excessive and disproportionate growth of individual large centres be overcome, which today seems to be an unavoidable evil.

Under the concept of the JSR one cannot speak about a contrast between the life styles of large towns and agglomerations and small towns, as erroneously held by some writers (for example V. I. Perevedentsev, A. S. Akhezer and A. V. Kochetkov). One must emphasise the background of this exclusive approach, which appeared in the Soviet Union in recent years in the problem of limiting the growth of very large towns, and also in the fate of small towns, and more precisely towns requiring development. It resulted directly from the social "demand" made of our scientific and planning departments. This "demand" appeared in several party and government resolutions. There has been a lot of practical work in the last decade, and particularly in the 1966 to 1970 period, in activating those towns requiring development. This was indispensable at this stage in the formation of the JSR for increasing the role of individual areas in the national economy.

The direction of the national economic planning of the forces of production and distribution of settlement over the country undergoes important changes in the various stages of the development of society. Thus in the political back-

[23] In the USSR towns of "average size" in a system are those with between 50 and 250,000 inhabitants (formerly up to 500,000). These towns are more economic from the point of view of expenditure in the urban economy.

ground to the formation of the JSR in the post-war years one can distinguish: a stage of the extension of the network of large towns — the local centres of *oblast* rank — through strengthening the industrial development of several "provincial" centres in the *oblasts* and Autonomous Republics (eg., Ryazan, Kaluga, Cheboksary, Kurgan); the stage of increasing economic activation of small and middle-size towns; the stage of the formation of a network of important focal centres within an *oblast*. These are the so-called regional centres where new industrial investment is now being concentrated as well as services to meet the needs of the entire population of the region within the *oblast*.

A very important practical political task in establishing the JSR is the control of the distribution of production and population in all the developed parts of the USSR. This task is difficult when dealing with local combinations of settlements. Under the JSR, recreational areas such as national parks, reserves and areas set aside for tourism and leisure, are as important in planning as industry, agriculture science and education. This will be very effective in improving the ecological situation. The JSR is a form of spatial organization which must be an organic combination of the natural and artificial environments.

The basic geographical problem of the JSR is the economic regionalization of the country. Only through this is it possible to distinguish regional systems of settlements of various rank, and to carry out a regional-network analysis which above all tries to define the location of the focal centres of population in the whole system. In economic planning the formation of the JSR is one of the tasks behind the politics of the distribution of productional forces. We should point out here that the formation of the JSR requires special criteria.

One is correct in assuming that the general criterion of the rational distribution of the forces of production is an increase in the effectiveness of the whole of production. This in its turn helps raise the standard of living of the population. This criterion is normally used in assessing the rational distribution of population and of the development of a settlement network. However we think this criterion is insufficient for the latter problem. One should take as a second criterion an improvement in the standard of living and the creation of opportunities for comparable living conditions for the population in the various regions and settlements of different size and type, from the village to the large town, throughout the settlement system.

One must see that the universal creation of comparable working and living conditions for the population is the most radical solution of the problems of rationalizing the distribution of production and regulating the growth of towns and so decreasing the demographic pressure on large town. At present, the rational and even distribution of production is unquestionably one of the important conditions for levelling the standard of living and for developing towns. This means that these economic and social problems must be treated together.

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SOCIO-DEMOGRAPHIC ASPECTS OF URBANIZATION IN THE USSR

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Urbanization is one of the most important processes in the development of society today. It is a complex and polyfunctional one. In studying urbanization, therefore, specialists in several scientific disciplines, must take part since even in introductory studies one can distinguish many elements in the urbanization process: technological, economic, geographical, ecological, political, sociological, socio-psychological, medico-biological, socio-demographic, moral, esthetical, and so on. But despite this necessary differentiation an integrative approach to the study of urbanization as a unified system is an imperative goal.

In the present study we would like to consider only the socio-demographic aspects of urbanization, in socialist countries. But first an explanation of what the authors understand by the expression "socio-demographic" is necessary.

Traditionally in demography, the demographic processes refer only to questions of human reproduction and changes in the age/sex structure. Sometimes in working this out one must take into account those mechanisms, such as migration, which contribute to the shaping of the population. We consider that in studying the demographic processes one must include qualitative indices of population development. Therefore, besides the demographic processes of reproduction and migration, one should include the distribution of population and the changes not only in its age/sex structure, but also in its nationality composition, plus those in the social, occupational and educational structure.

Thus we can relate these phenomena to the socio-demographic aspects of any social process. Under this complex integrative approach we would stress the close connection of the problems involved in studying the population structure with the whole of economic science and sociology, and with the geography of population in studying the distribution and migration of peoples. However, all the elements found in the process mentioned above, such as functional links, and mutual relations, being dependent on the changing socio-economic conditions, are appropriate subjects of enquiring in demography.

Which changes in reproduction, distribution and migration of the population structure itself, rapidly spread the development of the processes of urbanization?

Before we answer this question we must look at some of the limitations in our approach to the study of urbanization. The increasing rate of urbanization characterises the development of nearly all the countries of the world, including the industrially developing capitalist states and the "Third World" countries. In this survey we will limit ourselves to the spread of urbanization in the socialist countries.

Besides some general causes (the growing concentration of production, mechanization, and the liberation of the superfluous agricultural labour force)

urbanization under socialism also shows some fundamental qualitative differences. Whilst urbanization under capitalism is basically an unrestrained process, under socialism it shows regular features. Further, the very growth of towns is largely defined by the state ownership of land and the absence of private capitalist business construction. Finally, under socialism, differences in wealth have virtually no influence on the building and settling of different urban districts. We, of course, do not mention all the features of socialist urbanization as this is not our aim. We would merely like to point out that we will look not at the social-demographic aspects of urbanization as a whole, but in socialist society, taking the Soviet Union as our example.

Secondly, we would like to point out the most important features of this process of urbanization under socialism; these features are most concentrated in the large and largest towns.

Thirdly, we would like to turn our attention to the contemporary position and to those trends in demographic processes which will be brought about by future urbanization under the developing scientific-technical revolution.

We would first like to point out the influence urbanization has on the basic demographic processes.

Urbanization signifies fundamental changes in the division of population between town and country. The process of urbanization defined the post-war migratory trends in the country.

The basic changes in the social structure of the population during these years were closely linked with the process of urbanization and changes in the education and occupation of the urban population.

Essential changes in the indexes of births and deaths also depend on the processes mentioned above. The marked decrease in the number of births, both in the town and the village, is connected with urbanization. The lowest birth indexes are in the million-cities. The influence of urbanization on the number of deaths is also complex and conflicting.

Let us look in greater detail at the influence of urbanization on the above mentioned demographic processes.

What are the connections between urbanization and the distribution of population under socialism and what are the most important trends in migration? One must emphasize that these connections define different types of urbanization, which in a socialist country are inseparably linked with economic planning. In socialist countries urbanization develops side by side with industrial progress. This is evident from comparing the data on the growths of the urban population and the numbers employed outside agriculture (see Table 1).

The proportionality of urbanization and industrialization under socialism should not be taken to mean that the level of urbanization completely corresponds to the level of industrial development. There are no objective grounds for disturbing the proportions between the growth of industry and urban population since these processes are subordinate to the control of the socialist economy. A comparison of the processes of industrialization and urbanization testifies to their great commensurability in countries which were not industrialized under capitalism and which had a small urban population compared with East Germany and Czechoslovakia for example, whose urban population was 70% and 50% even in the first post-war years. This was due to the specific historical development of these countries, and to the urban structure of their industry which was dispersed among many small towns closely linked with village settlements through commuting. We consider, however, that if the data on the urban population of East Germany and Czechoslovakia could be supplemented by indices about the development of commuting, which is most wide-

TABLE 1. Increase of urban and non-agricultural population in socialist countries

Country	Year of census or estimate	Urban population (%)	Non-agricultural population (%)
Czechoslovakia	1950	51.2	61.4
	1955	53.5	66.0
	1961	52.4	76.0
	1965	61.0	8..5
German Democratic Republic	1952	71.3	77.2
	1955	71.6	77.6
	1960	72.0	82.5
	1964	72.9	83.5
Hungary	1949	36.4	44.5
	1954	39.1	54.7
	1960	39.8	60.4
	1963	41.7	65.8
	1965	43.3	67.6[a]
Poland	1950	36.2	42.8
	1955	41.9	46.6
	1960	47.3	52.3
	1965	49.4	56.0
Roumania	1948	23.4	25.8
	1956	31.3	30.6
	1965	33.7	43.3
USSR	1950	39.0	52.0
	1960	49.0	61.0
	1965	53.0	68.0

[a] 1964

[b] Narodnoye khozyaystvo SSSR v 1967, *Statisticheskii ezhegodnik*, Izdatelstvo Statistika, Moskva 1968.

spread in these countries, the levels of urbanization and industrialization would be even closer.

Over the thirty year period, 1940 to 1970, the urban population of the USSR rose from 33% to 56%. In many republics of the Soviet Union the urban population nearly doubled, and sometimes more than doubled; in the RSFSR it rose from 34% to 62%, in Armenia 28% to 59%, in Moldavia 13% to 32%, in Lithuania 23% to 50%, in Estonia 34% to 65% and Latvia 35% to 62%.

For such a large and variable country as the USSR one ought to briefly look at the problems of urbanization from a regional point of view; the division of the country into major economic regions is particularly suitable for regionally analysing the USSR. We will compare the proportion of the urban population of a region with the region's level of industrialization (see Table 2).

There is a high correlation between the regional indices of urbanization and industrialization ($r_{13} = 0.93$). A similarly calculated correlation of the level of industrialization and concentration of population in large towns (the ratio of the population of large towns to the total urban population), gives a moderate value ($r_{23} = 0.51$; Table 2) i.e. a higher concentration in the population of large towns is not necessarily related to a higher level of industrialization and vice versa. If one applies the proportionality of urbanization and industrialization to the regions, then the concentration of population in large towns is much

more weakly correlated with these processes. This conclusion is important for solving the problem of the socialist distribution of population. A pressing aspect of this problem in the well-known demographic "pressure" on large towns often leading to their excessive growth.

TABLE 2. Spearman's rank-correlation coefficients for the levels of urbanization, industrialization and concentration of urban population in large towns (calculated for Economic Regions, 1966)

Economic Region	Proportion of the urban population in the total population	Proportion of the population of large towns in the total urban population	Index of the level of industrial development	Ranking of the regions 1	2	3
Far East	72	34	1.19	1	18	5
North-West	72	54	1.41	2	5	2
Donetsk-Dnepr	69	53	1.34	3	6	4
Urals	68	52	1.42	4	7	1
Central	67	61	1.35	5	2	3
East Siberia	59	47	1.12	6	15	6
West Siberia	58	66	1.03	7	1	9
Baltic	56	49	1.12	8	12	7
South	54	57	0.81	9	4	11
Volga	53	60	1.12	10	3	8
Trans-Caucasus	50	47	0.73	11	13	13
Volga-Vyatka	49	51	1.03	12	10	10
North-Caucasus	48	51	0.81	13	9	12
Kazakhstan	48	50	0.70	14	11	16
Byelorussia	39	45	0.71	15	14	15
Central Asia	37	43	0.44	16	16	18
South-West	35	37	0.57	17	17	17
Central-Chernozem	34	51	0.72	18	8	14
Moldavian SSR	28	30	0.44	19	19	19
	$r_{13} = 0.93$	$r_{12} = 0.42$	$r_{23} = 0.51$			

Our calculation show that the present growth of urban population is linked with two main factors. Firstly, it is linked with the polyfunctional character of urban development, as a result of which the population of the diversely developed capital towns (of the republics) and *oblast* centres grows faster than in other towns. Secondly, it is linked with industrialization and new industrial construction, as a result of which newly built or reconstructed towns and weakly developed centres are the fastest growing towns, and become nodes of new concentrations of construction. Thus the "attraction" of a town does not directly depend on its size, or more precisely, this relationship is not a regular one.

The polyfunctional growth of a large group of previously weakly developed former "provincial", *oblast centres,* e.g, Ryazan, Kaluga, Cheboksary) in recent decades, led to an increase in the number of large towns. This allowed migration to be directed to these newly growing centres and contributed to an increase in the ratio of the population in the old large centres (Moscow, Leningrad, Kiev, Kharkov, Gorki, etc.) to the total population of the large towns. The network of towns with high order administrative function is equally distributed

over the whole country. At present, the policy of the distribution of production in the USSR aims at solving the problem of the polyfunctional development of a large group of towns which could become important regional or district (*okruzhny*) industrial and service centres within an *oblast*. This should lead to the directing of migration to somewhat smaller towns which are being transformed into just such centres. This will become a network of towns with middle level administrative competence and will be an intermediate link between the *oblast* centres and the administrative centres of the *raions*, which make up the lowest level in the settlement network of the country.

The multifunctional development of the branched network of variously renked centres leads to a distinct levelling of living conditions and those of man's upbringing in a great number of towns of different size; this social aspect is especially important for the growth of towns. It also creates conditions for a higher living standard for people in neighbouring areas and small towns, for whom the new centres of social activity, bearing in mind the progress in transport and other means of communication, will become more accessible than the *oblast* and, moreover the capital centres. This tendency towards population centralization continues, but its direction is changing, becoming "multicentral". This assists in implementing "the curtailing of the growth of large towns", whose "unswerving realization" was put forward by the Directives of

TABLE 3. The structure of the growth of the urban population of the USSR (according to the USSR population census) in %*

Sources of growth	Periods		
	1927–1938	1939–1958	1959–1969
Rural migration	63	62	46
Administrative changes	19	18	14
Natural growth	18	20	40
Totals	100	100	100

* *Voprosy narodonaseleniya v demograficheskoi statistike*, Izdatelstvo Statistika, Moskva 1966, p. 234; *Pravda*, 19 April 1970.

the 24th Congress of the CPSU on the five-year plan of the development of the national economy of the USSR 1971–1975.

The proportionality of the processes of urbanization and industrialization, referred to above is closely linked with the direction and magnitude of the processes of migration. Migration from rural areas helped to increase the urban population, whereas inter-urban migration redistributed the increase among towns of various size. The large-scale movement from the village to the town is a most important cause of urbanization. At the same time this rural-to-urban movement creates the necessary conditions for the further development of migration, since not only those migrating but also those remaining in the villages are affected.The continuing links between urban and rural inhabitants enables the rural people to find out about urban life; they also help further movement of rural inhabitants to the towns.

The influence of migration and its consequences are directly linked with the functions which make this process possible. The economic and social functions are the most important. The former creates the right qualitative and quantitative balance between supply and demand of labour in towns and villages. The social function is linked with the progressive, transforming in-

fluence of migration on man's personality, through forming and developing his ability to work, his growing needs and so on. Migration from village to town is an objective, regular process. The fundamental causes of this migration are: the demand for labour in the nonagricultural sphere of the economy, the different rates of increase of labour resources in town and country, the increasing technical equipping and productivity of agriculture, and the existing socio-economic differences between town and country. However, the urban population increases not only because of migration, but also through its natural increase and administrative changes of rural settlements into urban units. The action of these factors varies with the historical period (see Table 3).

From the table we can see that migration was very important during the first two periods for the growth of urban population. During the last period (1959 to 1969) the importance of migration had clearly decreased. Migration influences the changes in urban and rural population unequally. For the 1959 to 1970 period the urban population increased on average by 3.27 million a year, and the rural population decreased by 0.28 million a year. The natural increase in rural areas only partly compensated for losses through migration and administration. However, there was not a decrease in the rural population everywhere; in those places where there was a decrease, its rate varied. In recent years, despite migration to the towns, there has been an increase in the rural population in all the Transcaucasian and Central Asian republics, and in Kazakhstan and Moldavia. This is explained by the higher rate of natural increase and the small rural migration from these areas. The highest rate of decrease during the 1959 to 1970 period was in the RSFSR and Estonian SSR. This tendency often leads to a drop in the number of people of employable age in regions where there is currently a shortage of manpower in agriculture. The opposite situation is found in the Central Asian republics where the small rural migration leads to a pool of unused labour.

Thus, one cannot accept the size and definite geographical directions of the outward movement from the village as rational. The position is complicated by structure of migration, which is largely made up of young people with a higher level of education. The significance of rural migration, as with many other socio-economic phenomena, can be interpreted in more than one way. It is not only a means of redistributing the population over the country but is also an important element in the social development of the rural population, especially the youth. Youth is especially aware not only of the differences in cultural and living conditions between town and country, but particularly the different occupational and social prospects and the opportunities which the town can offer because of its modern industry, higher educational institutions, cultural centres, etc.

The process of urbanization in the USSR is inseparably linked with the changes in the class structure of the population. The proportion of *kolkhozniks* and workers in handicraft cooperatives in the total population has decreased over the 10 year period 1959 to 1968, from 31.4% to 21.5% i.e. by almost 50%. (It should be pointed out that the *kolkhozniks* form only half of the rural population). The proportion of factory workers and office workers (*sluzhaishchii*) grew during this period from 69.3% to 78.4% (of these 9,083,000 workers and office workers were employed in agriculture). The Soviet intelligentsia increased particularly rapidly. There were 20.5 million workers employed in "mental" work in 1959; at the beginning of 1969 there were already 29.9 million, which is 30% more than the number of factory workers and *sluzhaishchii*. About half of this group (15 million) had specialist qualifications. Naturally, most of the intelligentsia are found in the towns.

In the course of urbanization there were essential changes in the distribution of the labour force in the basic branches of the national economy. The proportion of those employed in agriculture and forestry (including the subsidiary private economy decreased from 1960 to 1968 from 39% to 29%). According to some forecasts for the year 2000 this may decrease to between 8% and 12%. The scientific technical revolution necessitates a redistribution of the labour force between the productional and nonproductional sectors, in favour of the latter. For example, the growth of industrial production in Moscow during the last five-year plan (1966–1970) was almost completely achieved through an increase in labour productivity without an increase in those employed in production, although the general level of employment in the national economy markedly increased. In the course of urbanization, as the number of large towns increases so there is a qualitative and quantitative increase in services (trade, food, everyday services, cultural and educational institutions, municipal economy, passenger transport, etc.). This tendency, on the one hand, leads to a change in the socio-occupational structure of the urban population, and on the other, opens up the possibility for an increased migration from the villages and small towns to the large towns, due to essential differences in everyday and cultural services. This migration, however, will not occur if suitable measures to raise the level of these services in rural settlements of various size are taken in time (using a developed system settlement links).

The growth of large towns signifies a great increase in those employed in cultural activities (learning, education, the arts).[1] The transformation of the largest towns into leading cultural, scientific and educational centres attracts streams of young migrants and fundamentally changes the structure of the urban population. For example, there are nearly 700,000 students in higher education in Moscow; these make up nearly 10% of this city of 7 million inhabitants. The presence of so many students inevitably lowers the overall fertility, but especially in the 19 to 24 age group. The rapid growth of science and the rapidly increasing employment in science and education help form certain basic trends in the urbanization process. Sometimes scientific centres are a city-forming factor, causing outward movement from the town to its suburbs; in the USA, for example, this is caused by differences in wealth.

Generally speaking, changes in the social, occupational and educational structure of the population are connected with urbanization, and especially with the growth of large towns; they strongly influence other demographic processes, especially urbanization.

As is well known, in the USSR, there is a continual drop in the birth rate which really began in the 1960's. Many factors influence the birth rate: socio-economic, cultural, living, biological and others. Urbanization is also one of these factors. Highly urbanized regions show a drop in their birth rate. The influence of urbanization on the natural increase in population is complex, and a simple comparison of the levels of urbanization and birth rate is not sufficient evidence of this influence. If we view urbanization not merely as an increase in the urban population, but also as an increase in the proportion of large towns and the diffusion of an urban style of life into the country, then we can see that it unconditionally influences the birth rate of the urban and the rural population and under present conditions both lowers the birth rates of towns and country and makes them more equal. From 1913 to 1967 the percentage of the urban population of the country rose from 18% to 55%,

[1] From 1960 to 1969 the number employed in education and culture rose from 4,803,000 to 7,777,000, in the arts from 315,000 to 403,000, in science, from 1,763,000 to 3,128,000. Thus the total employed in this sphere in 1969 was 11,308,000.

whereas the number of births per 1000 inhabitants fell from 30.2‰ to 15.5‰ in the towns and from 48.8‰ to 19.7‰ in the country.

This is largely linked with the organization of life itself, particularly in the large towns: the higher level of education and the growing needs of the population result in a different type of demographic behaviour between town and country, which is connected with a decreasing number of children in the family. Due to the predominance of migrants aged between 18 and 35, and among this group particularly males, the proportion of people in old age rises faster in the village than in the town. If the falling urban birth rate is due to a fall in the frequency of births and number of children from women of fertile age, then the rapid fall in the rural birth rate, particularly in recent years, is largely connected with a decrease in the total number of women of fertile age, and the altered sex structure of the rural population.

The differences in the birth rate between different large regions, and especially between republics are mainly connected with the level of urbanization. The births rate is much higher in those republics (above all those in Central Asia) where the proportion of urban population is much lower than the average for the whole country. Conversely, it is lowest where the proportion of the urban population is highest (the Baltic region and the RSFSR).

In connection with the study of the differentiation of the natural increase of population between town and country, a regional study of analogous differences among the urban population, particularly in towns of different size, can also be informative. For example, throughout the USSR, the highest fall in the birth rate has been in the million-cities. An analysis of birth rate indices shows that the birth rate is inversely proportional to the size of the town. The small towns and settlements are similar to the rural areas, where the birth rate, as is well known, is higher than in (larger) towns. If one recalls that migration is not only from village to town but also from small town to large town, then the small towns can be seen as demographic links between the large towns and the villages. At the same time one can observe certain similarities in the changes of the natural increase of population in the million-cities and in the small towns, because in these two categories of town there is the fastest rate of ageing; in the large towns this is due to the low fertility, and in the small towns, to the large migration of youth.

The process of urbanization and particularly the growth of the largest towns has a two-fold effect on the death rate. First, because of the increase in the standard of living and an improvement in medicine, the number of deaths from a variety of illnesses (especially infections diseases) has fallen, and the average life expectancy has risen. Second, the concentration of population, atmospheric pollution, sedentary life-style, and the psychological and nervous strains lead to an increasing number of deaths due to circulatory, tumour and traumatic illnesses. The highest death rates are found in the million-cities and small towns.

The demographic situation in the million-cities is causing great concern. The lowest birth rates and highest death rates in these towns lead to a rapid fall in the natural growth causes many problems, related to efforts to make up the losses in manpower in towns of various size, and to the deficit in manpower in large towns.

The study of the differences in the ways of making up manpower shortages in towns of various size and type is an important part of the study of socio-demographic aspects of urbanization.

All the above helps to confirm the great influence urbanization has on the more important socio-demographic processes in the USSR.

To sum up, we have demonstrated the proportionality of the processes of

urbanization and industrialization for the country as a whole and for the individual economic regions. The concentration of urban population in large towns is more proportional to the total urban population than to industrialization. This conclusion is important for solving the problem of the distribution of population. Migration of population from the village is also an important source of the growth of urban population. The great importance of migration is expressed not only in the redistribution of people of working age between town and country, but also in the creation of opportunities for the social advancement of the rural population, especially for the youth. However, its current dimensions, especially in some of the regions and its composition, makes it necessary to have a more effective control over migration. The more important consequences of urbanization are changes in the socio-occupational structure of the population: there is an increase in the proportion of factory workers and *sluzhaishchii* and a simultaneous decrease in those employed in agriculture, and rapid increase in the intelligentsia. The influence of urbanization on reproduction is complex. There is a fall in the urban and rural birth rates and a tendency for these rates to become equal. A lower birth rate is found in highly urbanized regions, and conversely, it is higher where the proportion of rural population is relatively higher. The birth is inversely proportional to the size of town.

In conclusion, we would like to mention the basic directions which should be taken up in future studies of the demographic aspects of urbanization.

(1) The mechanism of urbanization and the ways in which towns grow.

(2) Movement of population from village to town:

(a) size and direction;

(b) the effects on the village;

(c) the building of models and forecasting of migration processes.

(3) The problem of "demographic pressure" on the large towns.

(4) Urbanization and changes in the socio-occupational and educational structure of society.

(5) Urbanization and the natural increase population.

(6) The role of urbanization in general models of population distribution.

(7) Urbanization and the policy of town construction and demographic and social policy in contemporary society.

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DEMOGRAPHIC AND SOCIAL ASPECTS OF URBANIZATION IN POLAND

Witold Kusinski

Next to the population explosion, the process of urbanization is one of the most significant in the world today. "The processes of urbanization, apart from those of industrialization, constitutes the leading element of economic and social changes taking place in the contemporary world, including Poland", writes K. Dziewoński.[1]

The beginning of a rapid urbanization can be traced back to the 19th century. At present it continues at a very high rate arousing the great interest of many town planners, economists, sociologists and geographers.

The principal cause for both process of rapid urbanization and growth of urban population is the development of industry and of the other non-agricultural sectors of the national economy. The construction of new industrial plants and the extension of the existing ones, together with the growth of administration and services, creates a permanent demand for manpower. Consequently people swarm into the urban areas, thus promoting their further dynamic development.

In all countries that owe their development to industrialization, urbanization becomes an ubiquitous phenomenon and proceeds at a previously unknown rate. The quicker the rate and the broader the scope of industrialization, the larger the influx of people into the urban areas, and the larger the share of the urban population in the total population of the country.

Analyses of statistical data of the last 30–40 years have suggested the term "population explosion" as the most adequate description of the current demographic trend. Observing the advances in urban development as a process directly connected with population increase we can speak of an "urbanization superexplosion".

At the beginning of 1966, the world's total population amounted to more than 3300 million. In 1970 it grew to more than 3500 million. From 1950 onwards the world's population increased on the average by 60–70 million every year. At the beginning of the 20th century the annual rate of population increase was 1%. Today it is 2%, and by the year 2000 it is expected to reach 2.3–2.7%. Unless the present growth rate decreases after 1980 the world's population will exceed the 4000 million, and by the year 2000 that of 6000 million.

Population forecasts made in various countries, based on the present growth rate (which is unlikely to continue) for the next 100 years or so, present a cata-

[1] K. Dziewoński, Procesy urbanizacyjne we współczesnej Polsce. Stopień poznania, próba syntezy (Sum.: Urbanization processes in contemporary Poland. An attempt at a synthesis), *Przegl. Geogr.*, 34 (1962), 3, 459–506.

strophic picture. It is estimated that in the year 2050 the world's population will reach about 15,000 million, and in 2100 more than 40,000 million. Thus the mean population density will attain 300 persons per 1 km², an index characteristic of today's highly urbanized areas.

Of course, the above data are no more than estimates since future population increases cannot be predicted accurately, but if we disregard the question of the accuracy of our calculations, the rate and scale of growth of the population of the world and of the urban areas within it make it clear that urbanization processes must be scrupulously analysed, predicted and satisfactorily controlled. It must be borne in mind that the process of urbanization is spreading all over the world and is irreversible; all attempts to arrest the growth of cities by establishing rigid limits to their population size, putting up special registration requirements, or by any other administrative measures prove to be ineffectual. In this situation it is imperative to study the advance of urbanization, to explore its mechanism and to define the forms of urban development that would easily satisfy the economic, social and cultural needs of the urban population.

In the mid-sixties the urban share of world population was 32%. In the course of the 150 years from 1800 to 1950, the world's population grew a little more than 2.5 times, whereas the urban population grew 25 times. This latter growth was due mainly to the development of big cities (i.e. over 100,000 population). In recent years the growth rate of the urban population was twice that of the world's total population.

Forecasts up to the year 2000 indicate that the upward trend of the share of the urban population will continue. Preliminary estimates for the year 1980 suggest this proportion will be about 50%, and for the year 2000 about 75%.

The rapid growth of urban population both in absolute figures and in its share of the total population is found in many countries, which even quite recently have been predominantly rural in their demographic character. In the highly urbanized countries — the USA, Great Britain, the German Federal Republic and others — in which the proportion of the urban population is over 50%, the rate of urbanization is decreasing. The closer a given country is to the state of full urbanization (100% of urban population), the slower the rate of urbanization processes.[2]

Intensive urbanization can also be seen in Poland. At the turn of the 19th and 20th centuries the share of urban population was 26.6%. The First World War incurred considerable material losses and contributed to the depopulation of the cities. Consequently in 1921 the share of the urban population was only 24%. In the period between the two world wars even many economic difficulties, the underdevelopment of industry and other non-agricultural sectors of the economy, the high growth rate of the rural population which could not be absorbed by the cities (thus also increasing the rural overpopulation) could not prevent the spread of urbanization. The population census of 1931 showed that the share of the urban population had reached 27%. For 1939 it was estimated to be 29%.

The changes in the socio-political system and the intensive industrialization after the Second World War caused a rapid urbanization in our country. The first post-war census of 1946 revealed that 31.8% people lived in urban areas,

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[2] V. Davidovich, O kolichestvennykh zakonomernostiakh urbanizatsii v SSSR (On quantitative regularities of urbanization in the USSR), in: *Problemy urbanizatsii v SSSR*, Moskva 1971.

and in 1960 this reached 48.3%. Towards the end of 1966 the proportion of urban and rural population were the same, and the most recent census data (of 1970) indicates that more than 53.3% of Poland's population lives in towns and cities.

The growth of the share of urban population in the total population of Poland was caused by the natural increase, the influx of rural population to the towns and cities, and by the administrative changes, which granted the status of towns to other settlements and extended the administrative boundaries of towns and cities to take in the neighbouring rural areas of parts of the suburban zone. In the course of the 19 years between 1950 and 1969 the total population of Polish towns increased by 7,586,000. About 45% of this figure is due to natural increase, 29% to immigration from the rural areas, and about 25% to the administrative changes mentioned above.

By the end of 1969 Poland had 889 cities, towns and urban settlements. Since 1950 the number of towns and urban settlements has increased by 183.

Among Polish towns, small settlements predominate. The proportions of the individual size groups are presented in Table 1.

TABLE 1. Polish towns by size categories

	Town size (,000)						
	below 5	5–10	10–20	20–50	50–100	100 and above	total
Number of towns	352	231	165	91	26	24	889
% of the total number of towns	39.0	26.4	18.5	10.2	3.0	2.9	100.0

The towns and urban settlements are distributed rather unevenly over the country. On average there are 28 towns per 10.000 km². The network of towns is denser in the western than in the eastern part of the country. In the Poznań voivodship there are 33 towns, in the Wrocław voivodship about 50, and in that of Katowice about 97. In contrast, in the voivodship of Olsztyn there are 19, Białystok 16, and in Lublin only 13.

Although Poland's urban structure is dominated by small towns, the majority of the urban population live in the big cities (Table 2).

TABLE 2. Population in towns and urban settlements in Poland

Year	Total urban population	% of urban population in towns by size categories (,000)					
		below 5	5–10	10–20	20–50	50–100	above 100
1950	9,605	11.1	11.6	10.8	15.9	8.6	43.0
1960	14,206	8.5	11.6	13.2	14.6	9.0	43.1
1969	16,829	6.4	9.6	13.5	16.4	10.7	43.4

The data in Table 2 indicates that, as in other countries, the advance of urbanization in Poland is mainly due to the development of large and medium-sized cities in which most industrial investments are concentrated, and to the administrative, cultural and service institutions. These factors are responsible for the attraction of the towns to those emigrating from the rural areas or smallest towns, hoping to find new jobs and opportunities to improve

their financial and social position. The small towns themselves are stagnating in their role as limited local markets and service centres of their predominantly agrarian surroundings.

The post-war growth of the urban population has been dynamic. In 1950–1969 the urban population increased 1.8 times. Most towns and cities have registered a population increase. Only some of the smallest towns have shown population decreases, and are now deprived of any considerable possibilities for development. They have to big industrial plants, occasionally no industry at all. Their services and trade develop very slowly, and often they lack convenient traffic routes to the larger centres for which they might otherwise become satellite settlements.

The cases of stagnation and decreasing population observed in a number of small towns indicate that the crisis of small towns that occurred intensively after the Second World War has not yet been completely overcome, and it is still necessary to look for the ways to activate the towns in this group.

This problem of preventing the decline of the smallest towns is a concern not only to Polish geographers and economists. In the Soviet Union and in other socialist counttries also (though to a somewhat smaller degree in the latter) strenuous efforts have been made in this respect. The problem of small towns must become of special concern to those geographers working on the spread of urbanization. The small towns contain a considerable stock of fixed assets that should be put to better use. Moreover they must also fulfill important organizational tasks for their agrarian hinterland.

In contrast to the small towns, the medium-sized and big towns and cities developed dynamically after the war. An official publication shows that barely 15 towns of more than 10.000 population have failed to match their prewar (i.e. 1939) population number,[3] whereas the corresponding share for the towns of less than 10.000 population amounted to 40%, i.e. more than 230 towns.

The result of the rapid development of big cities which by their administrative, industrial and service facilities attract increasing numbers of people swarming in for new jobs, has been a significant change in the spatial patterns of individual towns and in the pattern of the settlement networks of particular regions. Both in the Middle Ages and in first centuries of the modern times, even in the initial phase of intensive urbanization, towns constituted compact spatial wholes delimited by their administrative boundaries. The pattern of town development was of an ever-increasing concentration of growing numbers of people in relatively small areas. In the initial period of industrialization, production plants and residential buildings were put up adjacent to each other within the administrative boundaries of the town, and this gradually increased the density of the construction development in these areas, which in turn created difficulties in the development of municipal traffic. The proximity of residential units and industrial plants did not stimulate the need for any intensive development of municipal transport. All these features had an inhibitory effect on the spatial development of towns. Occasionally, the location of defensive forts in front of towns has also hindered their development.

Since the beginning of the 20th century housing densities has begun to decrease and municipal transport has begun to develop. Accordingly, all free areas within the administrative boundaries were soon covered by new industrial construction, investments for services, municipal facilities and residential build-

[3] *Statystyka miast i osiedli 1945–1965* (Towns and settlements statistics, 1945–1965), GUS, Warszawa 1967.

ing units. In effect, towns began in a sense, to "spill over" their boundaries. The uncontrolled spatial development of the urban area created many economic, municipal, legal and other problems. In the Polish Peoples Republic this problem has been solved by incorporation large parts of the suburban zones into some of the big cities, thus providing an area of reserve for further construction development.

Since the development of the urban economic base (i.e. of all kinds of industrial plants and administrative, commercial and service institutions) usually precedes the development of housing construction, more and more people have to commute to the cities from the surrounding areas, sometimes from very far. This is helped by the development of different forms of transport, especially of large-scale passenger traffic. In effect, along the commuting lines there emerge numerous satellite settlements with no economic base of their own, but which live by functioning as central settlements.

The process of the "overspilling" of towns and cities involves more than merely creating satellite settlements. Economic and technological factors such as growing land rent, the necessity of putting up big industrial establishments demanding qualified manpower and convenient traffic lines, of securing the towns and cities against excessive noise and pollution, etc. — all these factors make it imperative to transfer industrial and municipal plants beyond the boundaries, though still in proximity to the cities. The result of such changes is that towns and cities cease being wholes confined by their administrative boundaries and become urban complexes — agglomerations or conurbations (depending on whether a single centre is predominant or there are several centres of comparable importance).

Currently, both in the capitalist and socialist countries the advance of urbanization is largely due to the creation of agglomerations and conurbations.

There are numerous examples of highly urbanized areas of the agglomeration or conurbation types inhabited by a few million or even tens of million people and with great industrial potentials. Suffice to mention the conurbations of the Ruhr Basin, the English Midlands, the agglomerations of Paris, Moscow, Leningrad, and others.

In Poland, too, urbanization advances by the growth of complex systems of agglomerations. Of the total 889 towns and urban settlements, 17 agglomerations can at present be distinguished, including the Warsaw agglomeration, the Upper Silesian Industrial Region, the agglomerations of Łódź, Poznań, Gdańsk, etc., which together include half the urban population of the country. The population density in the agglomerations is very high, generally exceeding 300 per 1 km^2. For Poland, this index of population density in small units can be used in defining a given area as urbanized.

The above data apply only to the biggest agglomerations, the central cities of which (the agglomeration cores) already have or are approaching a population of 100.000. It must be remembered, though, that smaller population concentrations are also developing, and that this development inevitably leads to the emergence of new agglomerations. Examples of this can now be observed in the regions of Sandomierz–Tarnobrzeg and of Konin–Koło. It is thus necessary of study both the agglomeration process (the mechanisms conductive to the emergence of urban agglomerations) and the measures that may be undertaken to prevent the harmful consequences of an overconcentration of population.

A characteristic feature of the urban complex is that the suburban population grows more quickly than that in the agglomeration core. This feature is to be observed in most cases. It can be explained by a movement from the central parts of the agglomeration to a more direct contact with nature, to

better air and more peace. Some of the central population move to the suburban or peripheral areas. Moreover it is in these regions that immigrants from distant areas can get flats more easily, and it is also easier to build one-family houses. In Poland this general trend toward peripheral and suburban areas was additionally vindicated by the administrative measures intended to reduce the number of registrations of new city inhabitants coming from outside. Some of the big urban systems in Poland (the Warsaw agglomeration, Upper Silesia) noted in their immediate vicinity — in the smallest administrative units (*gmina*) — a two-, three-, or even four-fold increase in the population number and density, while in the cities themselves the population number doubled only in a very few cases.

The dynamic advance of urbanization and the emergence of large population concentrations of a greatly differentiated social and occupational structure, lead to essential changes in the population structure of towns and urban agglomerations, in the natural movement of the population, and in its socio-economic behaviour patterns and in a great many sociological aspects. Moreover, the emergence of large urban agglomerations may incur significant modifications of the regional structure of the country's economy.

Two phenomena that occur in most countries are the distorted balance of the sex structure of the population which tends towards an increasing proportion of females, and the lower natural increase in towns and cities compared with the rural areas, mainly due to a decreasing fertility rate. In some cities, especially the largest, the natural increase is very small, and were it not for the influx of people from the rural areas and small towns, it would stagnate. After the war Poland witnessed a reversal of this common situation. In the five-year period of 1950–1955 the natural increase in towns and cities was bigger than that of the rural areas due to the large-scale immigration of young people, newly married couples, and single people who married in their new places of residence, and to a lowering of the mortality indexes.

TABLE 3. Natural increase in Poland (%)

Year	Total	Towns and urban settlements	Rural areas
1950	19.1	19.1	19.1
1951	18.6	19.2	18.3
1952	19.1	19.3	19.0
1953	19.5	19.8	19.3
1954	18.8	19.2	18.4
1955	19.5	19.7	19.4
1956	19.1	18.5	19.6
1960	14.9	13.0	16.6
1970	8.6	7.0	10.2

After 1956 natural increase in the urban areas decreased and at present it is about 4% lower than that in the rural areas. The natural increase index varies depending on the size of town or city. Generally, the natural increase in the big cities is smaller than in the small towns, and the latter in turn is not much different from that in the rural areas.

Changes in the natural movement of population, especially the rapid decrease in the fertility indexes, affect the age structure of the urban population and are the principal causes of the rapidly advancing ageing of the urban

population. The decreasing fertility rate and the lengthening of the mean life expectancy due to the achievements of medicine and the improvement of living conditions (including hygiene), are responsible for the decreasing share of the youngest age groups and the increasing share of old people, thus contributing to the ageing of the total population.

The ageing of the population is measured by the proportion of people aged over 60 (or 65) in the total population of a country or region. The Polish demographer, E. Rosset, considers a proportion of 12% people aged 60 or more the limit of demographic old-age.[4]

After the Second World War Poland had a very young population, but the process of ageing is proceeding rapidly. In 1956–1967 the population grew by 28.4%, whereas the population in the old-age groups grew by 79.6%. The advance of ageing was especially rapid after 1960. In the course of seven years (1961–1967) the total population increased by 7.7%, whereas those aged 60 and over increased by 34.8%. The rate of ageing is expected to fall slightly in the next few years because the large post-war generation is entering the reproductive age, but still it is going to continue systematically.

By 1967 the urban population had not reached the lower boundary of old-age; the share of people aged 60 or more amounted to 11.2% of the total urban population. In the rural areas this index was higher, 12.8% of the total rural population.

The lower share of old people in the total urban population is mainly due to the steady influx of emigrants from the rural areas. Taking into consideration the adverse balance of emigration (about 300,000 people in 1950–1969) the natural increase accounted for 8,057,000 people. Nearly all of this increment was absorbed by the rapidly developing towns and cities; the rural population increased in that period only by 836,000 people. Since young people constitute a majority of the migrants to the urban areas (more than 50% of them are 18–34 years old, whereas only slightly more than 10% are older than 40), internal migration is the main cause of the relative youth of the urban population. As the rural emigrants move principally to the big cities, they themselves are ageing at a somewhat lower rate than the level of fertility would suggest. The egeing of the population of small towns, especially of the smallest ones is much higher; the economic base develops at a very slow rate and many of these towns stagnate in a chronic economic and demographic crisis. The considerable regional differentiation of the level of ageing of the urban population must be emphasized. Ageing is more pronounced in central and eastern Poland, and is lower in the northern and western territories. This is due to the post-war large-scale migrations. Also, the ageing of the population is lower in areas of new industrial investment.

In studying the problem of ageing of the urban population of Poland it has to be pointed out that the rate of ageing of the urban population is much greater than that of the rural population. In 1960–1967, the share of people aged 60 or more grew in the towns and cities by 42%, whereas in the rural areas only by 28%.[5] These data suggest that in a relatively short time the more rapid rate of ageing of the urban population will result, given the limited immigration from the rural areas, in the urban population becoming very old.

The rapid process of ageing, especially of the urban population, creates

[4] E. Rosset, *Proces starzenia się ludności* (The process of ageing of the population), Warszawa 1960.

[5] *Wyniki badania struktury ludności według płci i wieku. Stan w dniu 31 XII 1967* (Results of a study of the population structure by age and sex as on December 31, 1967), GUS. Warszawa 1969.

many economic and social problems. Their solution, the explanation of the mechanism of ageing in different regions and urban groups, the consequences of this process for manpower resources and the perspectives for the various sectors of the national economy, for municipal and housing constructions; and the indirect effects of ageing on the spatial structure of the towns and cities — all these should become subjects of interest to geographers working on the processes of urbanization.

The advance of urbanization is not only limited to the growth of the towns and cities, urban agglomerations, and changes in the population structure. It also leads to far-reaching changes in the socio-occupational structure, to a steady relative decrease of agricultural employment because of technical progress, to a growth of the share of industrial employment and of those engaging in various services. This phenomenon has a ubiquitous character, and occurs both in the advanced countries and in those that started towards a change in their economic structure relatively recently. A comprehensive development of the economy, including the development of modern agriculture, is possible only by relieving the agriculture of the excess manpower resources and by equipping the agriculture with efficient machinery, fertilizers and technological means, by carrying out systematic land reclamation, etc.

The changes that are taking place in the occupational structure, particularly the abandonment of agricultural jobs and the dynamic growth of non-agricultural occupations, are the principal causes of the emigration from the rural areas. However, it often happens that a new job or a new means of subsistence do not lead to a change of the place of residence. Some of those abandoning their jobs in agriculture stay in the villages and commute to work in the urban areas. Sometimes this is a necessity because of family relations, difficulties in obtaining flats in towns and cities, farm ownership, and sometimes a question of choice as in the case of those reluctant to leave their native village or to give up the convenience of close contact with nature.

Emigration from the rural areas and commuting to work, which are expressions of the changes taking place in the occupational structure, give rise to a number of economic problems. These include the inflow of financial resources to the rural areas the increasing demand, the need to develop and improve the transport system, etc. At the same time a number of social problems arise. These processes link the urban and rural population in many different ways. They allow some transmission of the urban customs, attitudes and behaviour to those people living in the rural areas, and are undoubtedly an integrating factor in society as a whole in helping to overcome the existing disparities between the city and the village.

In the inter-war period Poland was basically a rural-agricultural country as the majority of the population made their living in agriculture. The National Census of 1931 showed that only 40% of the total population made their living in non-agricultural jobs.

Since non-agricultural jobs have more convenient working hours and ensure a more stable income, the occupational activity of people having non-agricultural jobs is generally lower than that of the agricultural population, as indicated by the indexes of economic activity (more than 55% and less than 50%, respectively). In the census year of 1931, the share of people working in non-agricultural jobs in the total employment was 36.2%.

In the post-war period, due to the intensive development of industry and of the other non-agricultural sectors of the economy, plus education, the health service and culture, fundamental changes in the occupational structure of Poland's population have taken place. In 1950 the non-agricultural population

constituted no less than 52.9% of the country's total population; in 1960 this index increased to 61.6%, and in 1970, as shown in the last National Census, it exceeded 70.5%. These data show haw fundamental is this change compared to the pre-war period.

Most of the non-agricultural employment is concentrated in the towns and cities. At present more than 96% of the urban population have non-agricultural jobs. There are towns in our country, especially in the eastern voivodships (those of Białystok, Lublin, the fringes of the Warsaw and Kielce voivodships) in which the agricultural population constitute nearly a half of their total population, sometimes more than 50% (and in one extreme case even more than 80%). But this is not a large-scale phenomenon, and occurs only in the smallest towns that received their town status a very long time ago, and have kept it by tradition.

The change in the occupational structure due to economic development is especially conspicuous in the rural areas. In the inter-war period only 15% of the 25 million rural population made their living in non-agricultural jobs. A characteristic phenomenon of many regions (the voivodships of Cracow, Rzeszów, Kielce) was the excess agrarian manpower, which, depending on the method applied, is estimated to have been between 2.5 and 8.8 million persons that could have been transferred to the other sectors of the national economy without any loss in agricultural production. After the war the problem of the excess of agrarian population greatly diminished, though there is still surplus manpower resources in several areas. These cannot easily be moved to other areas due to the existing agrarian structure, family ties and other (sometimes personal) reasons. Besides the partitioning of the big farms of the land-owners and the removal of some people from the overpopulated areas, intensive industrialization was responsible for the liquidation of the agrarian excess manpower. By creating a great demand for monpower, which was recruited even from distant regions, the development of industry extended urbanization into the rural areas, which can be seen particularly in the systematic growth of the population making its living in non-agricultural jobs.

In 1950, 75% of the rural population made its living in agriculture. Sixteen years later, as shown by the afore-cited "Results of a study of the rural population structure", more than 36% of the 15 million rural population mentioned non-agricultural jobs as their main source of income. At present this is estimated to be 40%.

The proportion of people earning their living in non-agricultural jobs is at its highest, about fifty percent, in the vicinity of the big industrial districts, primarily in the areas surrounding the Upper Silesian Industrial Region, the Warsaw Industrial District, the Wałbrzych District, Łódź, Cracow and Poznań. This phenomenon is also pronounced around the well-developed or intensively industrialized urban areas. The distribution of the rural population working in non-agricultural jobs largely coincides with the areas of maximum population density, i.e. areas of density 150 and over per 1 km^2. This indicates that the relation between the density of population and the proportion of non-agricultural population in the total rural population can be determined by means of correlation procedures.

A characteristic feature of the changes of the occupational structure of the rural population is the high proportion of those having two jobs.

This proportion is particularly high among the rural population who regard non-agricultural jobs as their main source of income (they are called in Poland worker-peasants), whereas it is lower among the agrarian population (peasant-workers). Nearly 52% of the total non-agricultural peasant population of the

whole country also work in agriculture. The data showing the share of workers-peasants in the northern and western areas of the country differs markedly from this average figure. Almost everywhere in these areas the proportion is smaller than the national average, a result of the different demographic structure and the better economic possibilities than in the remaining areas. In the central and eastern territories the proportion of worker-peasants is generally higher than the national mean.

It must be emphasized that in the more industrialized areas, in the areas that were industrialized earlier, and in those that have more convenient and closer traffic connections with the bigger urban centres, the number of worker-peasants is smaller than in those areas where agriculture predominates in the economic structure. It is interesting that the analysis of the spatial differentiation of the proportion of peasant-workers (people employed in agriculture and having additional sources of income from non-agricultural jobs) shows a similar picture. The share of peasant-workers is lower in the regions of big cities and urban agglomerations than in the more remote areas. This indicates that in these areas both the occupational structure and the orientation of the advance of socio-economic aspect of urbanization have become stabilized. But they may change under the effect of new factors.

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The problems of urbanization are very numerous. In analysing the advance of urbanization various aspects can be considered. The Polish sociologist, J. Ziółkowski, mentions four; the demographic, the economic, the spatial and the sociological. This paper indicates only some of the demographic and social problems of urbanization in Poland. Many related problems have not been touched on. Nor have we considered the problems involved in the spatial development of towns and cities; those concerning the protection of the environment in the urbanized areas as well as the numerous and diverse sociological problems which do not fall into the scope of the research of geographers, but are important for a full understanding of the process of urbanization.

It seems that in view of the significance of the urbanization processes in the contemporary world it is necessary for geographers to undertake scrupulous studies of the advance of urbanization in order to explain the mechanisms of its observable diversity and differentiation in space.

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GEOGRAPHICAL ASPECTS OF URBANIZATION

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Urbanization is a universal, complex and multi-faceted process. Thus it is difficult to find a concise definition which fully covers all its major features.

Being a result of many factors, urbanization in turn affects all aspects of life in contemporary society. But above all urbanization signifies a change in man, in his interests and behaviour, the intensification of his activity, changes in the use of his free time, his goals, outlook and so on; in other words, all that can be covered by the term "way of life". Changes in the style of life are linked with changes in the urban environment, which in turn are the result of development of productive forces and productional relations in a society.

The social system defines the socio-economic type of urbanization; it is more or less the same for countries having the same social system and a similar level of development of productive forces. Many features of this world-wide phenomenon of modern urbanization result from the scientific-technical revolution which dates from the middle of the 20th century.

Because urbanization is complex and many-sided, with a diverse influence on the development of a society and its environment, it is very important to study urbanization through a variety of scientific disciplines. Such an approach, using the knowledge and methods of various sciences has become typical of inter disciplinary cooperation.

This complex approach is important firstly, for working out a general theory of urbanization, and secondly, for defining the place and role of individual disciplines in examining this problem. Given the conventional character of the "line of demarcation" among the students of different disciplines in studying urbanization, it is nevertheless possible to define those aspects and problems in which geographical analysis is most important.

Urbanization appears in many forms, and these greatly depend on a series of areal factors. The complex process of urbanization is geographically differentiated. Thus without discovering and studying the concrete forms of urbanization it is impossible to recognize its essence and regularities.

The most widespread elementary indices which allow one to assess the achieved level of urbanization are: the proportion of urban population in the total population of a country or region, the level of development of the network of large towns, the degree of agglomeration and of movement of people (commuting). However, these indicators are not sufficient either for characterizing such important aspects of urbanization as the concentration of functions and life styles, or for characterizing the environment in which urbanization takes place. It is essential to discover the processes which make up the areal

structure of urbanization and particularly of settlement. The study of the areal structure of urbanization (by which one understands the relations and mutual links between areas of different levels and character of urbanization), areal differences (between countries or regions) in the level of socio-economic development, of the rates of urbanization, the relations between urbanization and industrialization, the settlement system, the character of the urban network, the conditions of the natural environment and its changes resulting from the urbanization process — all of them have the aim of making urbanization more concrete and shed more light on all that refers to the specifically geographical aspects of investigation. The task of this investigation is to reveal the forms of urbanization and their geographical variations.

In differentiating two planes in the study of urbanization, the general-theoretical and the concrete, one must take as ones point of departure that the geographical aspect means directing the investigation towards the characteristics of urbanization and revealing the features of the concrete type of urbanization. The latter is a result of the action of a complex of social, economic, natural and other factors, which vary over space. The different processes of urbanization have their own geographical expression.

It must be emphasized that the results of urbanization clearly mirror the socio-economic and political conditions in which this process occurs. In capitalist countries the spontaneity of urbanization deepens the social disparities. In socialist countries one can effectively control urbanization; but this control is not automatic, and one must study the process of urbanization and the cities as the bearers of urbanization in depth to make it really work.

In developing countries urbanization is currently one of the important factors in the development of the national economy and culture, having a great influence on the formation of economic regions and on the whole spatial structure of economy. The unrestrained nature of urbanization in these contries is shown in the excessive rural-urban migration in relation to the development of manufacturing. This phenomenon is described in foreign literature as "pseudo-urbanization".

The areal structure of the economy of countries and regions greatly influences the scale and rate of urbanization. Thus the historical dispersion of urban settlement in Czechoslovakia influenced the dispersion of industry; as is well known this complex distribution of industry shows much inertia. This dispersion is particularly pronounced in those branches of industry such as textiles, glass, porcelain and earthen ware, wood processing, paper-cellulose and building materials. It is pronounced even in the machine building industry.

The way in which the nation's territory has been formed (differently for different countries) is clearly mirrored in the nature of its urbanization. For example, in France, which has for a long time been highly centralized, the course of urbanization and its attendant problems differ from those in conglomerative states in which political unity came much later (in Italy and Germany for example). The important aspects of urbanization are whether it is fully developed throughout an area or whether it is concentrated in centres, the areal differentiation of urbanization and the distribution of the highly urbanized zones. The inertia of historically formed settlements continues to influence the types of settlement over a long period.

In Brasil, for example, there is a characteristic urban zone along the Atlantic coast, where the basic economic centres oriented entirely to the external market grew up. At the same time the internal agricultural-raw material areas, widely dispersed in a basically agrarian economy, have a low level of urbanization.

The geographical study of urbanization is not simply mapping these or

other indices of world urbanization and showing their many spatial variations. We are not talking about non-essential, external areal variations with no influence on urbanization, but about those concrete areal forms which are organically linked with the properties of urbanization itself. Therefore the investigation of its form (partly through cartography) is an assessment of the influence on urbanization of geographically differentiated factors.

Let us try to outline some most important geographical aspects of urbanization, and thus demonstrate its mechanism from a geographical point of view:

(1) Urbanization is the result of the development of productive forces which influence the distribution of population through the spatial structure of the national economy. These two factors largely dictate the way in which an area is used under given natural conditions.

(2) In the course of urbanization a new urbanized environment is created (a rather complex concept). From a geographical point of view this concept refers above all to the process and forms of settlement, but also to the natural environment in which rapid and far-reaching changes occur under the influence of urbanization, especially under the contemporary scientific-technical revolution.

The geographical analysis of the distribution of population, which aims at analysing the urban environment, takes in a wide circle of problems. It begins by studying the areal structure of urbanization — the interrelations, mutual positions and configuration of zones or areas with different levels and directions of urbanization can be found by analysing the structure of the population distribution, in the course of which one would examine the structure of settlements, relations between the different types of settlement, and the relations and mutual links between urban and rural settlements.

The nature of the urban network is very important, especially the degree of its maturity, the level of development of the network of large and very large towns, the sharpness of the hierarchy of urban settlements, the intensity of development of large urban agglomerations and their important economic effects, and also of sub-urban settlements, and the formation of large, highly urbanized areas during the process of agglomeration (megalopolis, etc.).

The changes which take place in the branch structure of the economy and in social relations under the scientific technical revolution, alter the life-style of the population.

In relation to the above, the geographical study of the contemporary urban settlement in the current stage of urbanization focuses on questions such as commuting (this being a reflection of the growing importance of towns as centres of population and the influence of the town on rural settlements), the migration of population, the distribution of labour resources and how these change under urbanization.

Thus in studying the spatial expression of the processes and results of urbanization, three related groups of questions are important for the geographer.

First, an analysis of the areally expressed factors of urbanization. The purpose is to find out how the urban environment is formed, and to discover the regional features in the formation of a settlement system under the influence of productive factors.

Second, being particularly important, concerns the characteristics of settlement and the natural environment, which change in the course of urbanization and create the conditions for man's upbringing, his spiritual and physical development.

The third group includes such questions about the study of man which are traditional within the framework of human geography. These questions attempt

to show the results of urbanization, which are reflected in the growing movement of population (territorial redistribution of population, commuting), in the employment structure (the discovery and analysis of areal variation in the employment structure can be a good indicator of the level of urbanization) in the degree of preparedness of the population to take part in the national economy and especially in its leading progressive branches (the levels of general and specialized education, etc.).

These three groups of problems are closely linked. One must analyse the factors which give rise to the characteristics of the environment. In examining the determinative influence of production and the territorial structure of the economy on the development of the settlement system and changes in the natural environment, one must also assess the feedback effects, i.e., the influence of settlement on the future territorial organization of the economy, and the influence of the urban environment on the branches and spatial structure of the economy.

Man and his social functions (life style, the type and intensity of his activity, leisure, movement and outlook) change with an increase in the level of development of productive forces under the influence of scientific technical progress. Man's upbringing takes place in different ways according to the socio-economic conditions in areas of varying levels of urbanization, under different forms and systems of settlement, and under different natural environments.

A series of sociological factors influence the formation of the settlement system, the development of spatial links between settlements of an urban agglomeration, and the planning of settlement centres. These factors include: changes in the life style, new ways of spending leisure time, increasing mobility, a growing attraction towards the largest centres with high socio-informational potentials, the development of non-professional contacts, and many others.

In order to define the type of urbanization (finding out important features such as its rate, direction and maturity) it is important to look at the relations between urbanization (e.g., concentration of population in the largest centres and agglomerations) and the level of development of the economy (e.g. the level of industrialization, *per capita* income, etc.).

To assess the spatial differences in the course and level of urbanization more accurately, to look at it from a geographical point of view, one ought to map these features of urbanization.

Small scale typological maps of urbanization for the whole world and for individual continents would give each country its general type of urbanization from socio-economic and geographical points of view.

The preparation of such a general map should be preceded by the preparation of maps showing the most important indices of urbanization.

The task of selecting indices is an important one. They must accurately reflect all the basic features of the process and results of urbanization, and allow one to discover its most important spatial properties.

In connection with the three groups of problems outlined earlier, which between them cover the geographical approach, one can propose three groups of indices:

(1) Geographical factors (i.e. areal differentiation). These factors direct the formation and changes in the urbanized environment, and also the level and nature of the feed-back effects. To this group those indices which enable one to assess the correspondence between the levels and rates of urbanization and economic development also belong.

(2) Those indices which characterize the urbanized environment, namely:

the distribution of population, the settlement systems (their maturity), the conditions of the natural environment, and how fast the processes occur.

(3) Those which describe the population, i.e., those concerning the changes in the intensity of man's activity and in his life-style.

Finally, and absorbing task would be to construct an integral, synthesized index (or indices), which would take in a series of partial indices describing different features of urbanization and in such a way make possible a generalized characteristic of urbanization covering its more important and organically linked aspects.

The investigation of the geographical aspects of urbanization requires the concerted efforts of research workers in many countries. Moreover this could help to develop the collaboration of Polish and Soviet geographers. Especially important here would appear to be common work on perfecting the methods of investigation and a regular exchange of knowledge and results of current research.

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URBANIZATION AND ETHNOGRAPHIC PROCESSES

Vadim V. Pokshishevski

The processes of urban development are "universal" (for the many forms involved, depending on the system of production) and give rise to varied social effects. An important aspect of these effects is the influence of urbanization on ethnic processes,[1] which has so far been underestimated by geographers engaged in urban geography.

Research on the impact of urbanization on ethnic processes is becoming very important in countries with a multi-varied population structure. The author analyses this problem, mainly for the USSR, a land populated by more than 100 nations living in a close community and faced with a great urban expansion. The author is of the opinion that many aspects ot this problem have transformed analogies abroad, particularly to the numerous developing contries.

The growth in the level of urbanization is accompanied in the USSR, as in other countries (though in the USSR particularly) by the important penetration of the many features of the urban way of life into rural areas. In this connection, it is worthwhile to recall that reducing urbanization solely to the quantitative increase in the ratio of urban population to the total population is possible only if this is considered an approximation (although this is a very important index of urbanization). The next essential feature of urbanization, though only quantitative one, is the increase in the proportion of those, living in the large and largest cities of the total urban population. The statistical data for the USSR on this point is given in Table 1.

Urban development is known not only to radically change the "statistical structure" of the population (proportions of urban and rural populations), but is associated in the mind with the transfer of the urban way of life to rural localities. It is because of the mobility of town residents and their access to information that their impact on social (and also ethnic) self-determination may be considerably greater than their proportion of the total population. This can be seen in the USSR and other countries also (this being particularly important in the USSR is explained later in this paper).

Currently the traditional idea among ethnographers and geographers that the countryside is the "mainstay of ethnographic features" (as opposed to the

[1] There were strong appeals at the International Congresses of Anthropologic and Ethnographic Sciences VII (1964) and VIII (1968) to make ethnography "the face of the city" and demands for a further "demographic trend" within the broad scope of ethnographic research; the problems of urban population are moving discernibly ahead in ethnographic and ethnodemographic research.

TABLE 1. Demographic conditions for an increase in the effect of urbanization on ethnic processes (given in whole percentage figures)*

	Census or computed years			
	1926	1939–1940	1959	1970
I. Proportion of the urban population in the total population of:				
(a) the USSR	18	33	48	56
(b) Union Republics (the RSFSR not included)	18	30	42	50
(c) Union Republics (the RSFSR and its Autonomous Republics not included)	16	29	41	49
II. Proportion of city inhabitants who live in:				
(a) cities with more than 100,000 population	41	46	49	55
(b) cities with more than 0.5 million population	16	21	24	27
III. Proportion among the population of the Union Republics (the RSFSR not included) and Autonomous Republics incorporated in the RSFSR of:				
(a) inhabitants of cities with more than 100,000 population	13	19	19	25
(b) inhabitants of cities with more than 0.5 million population	1	5	9	12

* Calculated from the data in: *Itogi vsesoyuznoy perepisi naselenya 1959 g. SSSR* (svodnyi tom), Moskva 1962; *O predvaritelnykh itogakh vsesoyuznoy perepisi naselenya 1970 g.*, Soobshchenye CSU SSSR, Moskva 1970.

towns, which are considered to be "anti-ethnographic" with their material culture and with their mixture of ethnographic components) — is undergoing a revision. Such a notion was justified for the historical period during which towns presented a kind of "demographic exception" because of their low population numbers, and the ethnic sub-stratum was believed to be a phenomenon spread over a whole country, a phenomenon that was not subject at that time to the social conscience. Both these premises are no longer relevant, at least not in the USSR, and particularly not for the leading nations forming the Republics of the Union and their incorporated Autonomous Republics. The simultaneous development of commodity and monetary relations has led to an influx of manufactured goods and factory products into all rural areas that has considerably weakend a "spontaneous" and an insufficiently conscious ethnographic character and of its associated material culture.

The joint effect of urbanization and ethnic processes involves many historical, social, demographic, and town planning features. The latter can be seen particularly in developing countries, which often preserve separate ethnic settlements or districts within town boundaries. They can also be seen in highly developed capitalist countries having racial segregation or mass immigration, which leads to preferential residential districts. The resulting "nodes" or "junctions" of interaction — of urbanization and ethnic processes, have led to this interaction being a particularly fertile field for geographic research, because the complex nature of geography essentially aims at detecting ties between these kinds of phenomena.

It is generally known that cities, particularly large ones having an area from which they attract migrants considerably exceeding the original ethnic region with which the city has been developing, frequently become multi-nation-

al centres. The multi-national composition of population of the overwhelming majority of cities in the USSR are not only the result of their historical past which often favoured the migration of various nations over long periods (including particularly the migration of Russians to cities throughout the USSR). It is also, and above all, the result of Lenin's national policy during the period of the building of socialism, a policy that allowed representatives of all nations "to put down roots in the cities". Lenin's national policy at the same time strongly stimulated the national consciousness and ensured a rapid growth in culture, socialist in content and national in form, to all nations of the USSR. This policy is also reflected in the organization of the state, in the system of the multi-stage national and state formations (the Republics of the Union, Autonomous Republics, Autonomous *Oblasts,* National *Okrugs*).

The development of various national and state organs was accompanied by an accelerated expansion of the economy into the non-Russian areas (particularly through industrial growth), and led to rapidly expanding urban centres in these areas. Those centres have also become focal points for the development of national culture and ethnic consciousness. It was in these centres that headquarters of scientific institutions were established in order to educate national labour force of skilled workers and professionals; social institutions and organizations which carried out the research on and development of the national culture were also established. These centres have furthermore become sources of literary and publishing activities and of broadcasting in the national language, etc. These cities need national personnel to be employed in management and for intensively training the national labour force. This is why they have become centres which attract the rural intake of the indigenous population. (Sometimes they attract representatives of nationalities from beyond the boundaries of their ethnic territory, i.e., from other Republics of the Union, including urban inhabitants from such Republics). Thus one can state at the present time it is probably the cities, more than the rural areas in the USSR, that are becoming "carriers of ethnic features".[2]

A similar process of cities becoming the centre of ethnic features, but with different forms, can be seen in many less developed countries; this applies particularly to those which gained independence during the last decade. Here, at the initial stage of emergence of a nation, apart from being ethnically "mosaic", the cities in these countries play an extremely important role as the "ethnic uniter".

The occurrence in the USSR of major national groups, normally living in adjacent Republics, Autonomous Republics, etc. in the composition of the urban population of a certain national area, may sometimes be the outcome of

[2] An interesting example is presented by the Armenian cities, particularly by Yerevan. With a very high proportion of Armenians (93% according to the 1959 census) in the city's population we can consider the city as uni-national. The influx of Armenians to Armenian cities from beyond the republic (including immigration from outside the USRR, by repatriation), marks a turning point in the historical process of the "Armenian Diaspora", which has dispersed the martyred Armenian nation over numerous countries. We must recall that during the 18th and 19th centuries the Armenians founded many settlements over the present area of the USSR beyond the original boundaries of Armenia (the territory of the Armenian Soviet Socialist Republic of today was incorporated into the Russian Empire ar early as the 1820's). According to the 1959 census, 55.7% of the Armenians in the USSR lived in Armenia; 15.9% lived in both neighbouring Georgia and Azerbaidzhan. One should stress at this point that the Armenians, including those outside Armenia, are a relatively "urban" people (in 1959 — 57% of them lived in urban areas; the average of the USSR was 48%). Armenians who move to the cities in Armenia have usually already acquired an urban way of life, and an "urban profession".

historical settlement circumstances (eg. the Tadzhiks in Samarkanda and the Armenians in Tbilisi). This many at times also reflect a drawing together of the individual nations (eg. the attraction exerted by Kazan upon the nationals of neighbouring republics, e.g., those of the Volgan-Vyatkan and the Ural regions). This is accompanied by neighbouring nations (which for this if for no other reason are subjected to the economic and cultural gravitation towards cities), having their own ethnic territory within a particular republic, and sometimes also an autonomous status. Thus, the effect of Tbilisi on the Ossetians differs from that exerted on the Azerbaidzhans for example.

The mechanism of the formation of national composition of the urban population in the Union Republics and in the Autonomous Republics is determined by the relation of two mutually opposed trends. The first trend is the influx of the native population to these towns. This is the result of a planned policy of accelerating the training of home staff for the "urban professions" on one hand, and on the other of releasing the native population from the rural areas as the mechanization of agriculture gains headway. The demand for labour at the same time increases rapidly in towns due to the growth of the economy, which is particularly concentrated in urban areas; one should not ignore in this connection the quality requirements of such labour (skill, training in "urban professions"). Should the demand for "urban" staff outstrip the rate of training

TABLE 2. Changes in the total figure, and national composition of the population of the capitals of four Union Republics of the USSR

City	Year	Population in thousands	National composition of the population in %		
			natives	Russians	others
Baku	1897	111.9	36.0	33.4	30.6
	1926	425.9	26.3	35.3	38.4
	1959	987.2	37.7	34.2	28.1
Kiev	1897	247.4	22.2	54.4	23.4
	1926	513.6	42.2	24.5	33.3
	1959	1104.3	60.0	22.7	17.3
Tashkent	1897	155.4	75.1	9.7	15.2
	1926	323.6	52.6	32,4	15.0
	1959	911.9	33.9	43.8	22.3
Tbilisi	1897	159.6	26.4	28.0	45.6
	1926	294.1	38.2	15.6	46.2
	1959	694.7	48.5	18.2	33.3

through the influx of native population, labour from beyond the boundaries of a particular ethnic territory would be "drawn in" instead. In pratice, this very often leads to an increase in the proportion of Russian (as well as White Russians and Ukrainians attracted in the same way) in the population of a particular town.

Both the above trends are most clearly seen in the capitals of the Union Republics which have become at the same time the leading economic centres of their Republics. That the above trends are mutually opposed, is illustrated by the examples in Table 2.

The transformation of Tashkent under Soviet authority, not only into a large

capital city, but also into a first order industrial centre, has caused such a great demand for trained labour that it has proved impossible to meet this demand solely by training the native population within scheduled time periods. This explains the rapid increase in the proportion of Russians (although the native Uzbek population has also grown rapidly; it increased by 140,000 from 1926–1959). The population of Tashkent has almost tripled during the Soviet era, while that of Baku has increased scarcely more than twice. This growth resulted both from an outside influx and the natural increase. The Azerbaidzhans and Russians in Baku, which was an important industrial centre even during the pre-revolutionary days, have grown in number. The proportion of the third leading national component, the Armenians, has diminished in Baku, while the Persians who migrated to the city during the earlier periods as unskilled labour employed in the operation of oil wells, have disappeared altogether. It was the "industrial past" of Baku that stood behind the rapid rate of training of new personnel recruited from the native population; this has resulted in an almost unchanged proportion of Russians in the population of the city.

The great achievements in the training of native labour in Tbilisi during the Soviet era has resulted in the native population approaching 50% of the total number of inhabitants (the number of Armenians in Tbilisi exceeded that of the Georgians up to the Revolution and during the first years of Soviet authority). The influx of Russians and Armenians during the Soviet era has been negligible, and their proportion to the total number of inhabitants in Tbilisi has decreased sharply. There has been a considerable influx of Ossetians (which is due to the incorporation of the South-Ossetian Autonomous *Oblast* into the Georgian Soviet Socialist Republic), and of certain other nations, represented in Trans-Caucasia by their largest ethnic enclaves (the Kurds, the Greeks). The increase in the number of Georgians in the population of Tbilisi (about 224,000 during the period 1926–1959) was also accompanied by an assimilation of part of the autochtonic population. Thus, almost 12.5% of the Armenians and nearly 20% of the Ossetians in Tbilisi considered the Georgian language their native tongue in 1959.

The proportional increase of the Ukrainians in Kiev was the result of two simultaneous factors that followed the same trend, i.e.: (1) the influx into the Ukrainian capital of Ukrainians from all over the Ukrainian SSR (including the nearest neighbourhood); (2) the further consolidation of the Ukrainian nation, due to a growing national consciousness. This resulted from the great achievements of Ukrainian culture. It can be assumed that a part of the Kievans who hesitated over admitting their Ukrainian nationality,[3] later acknowledged this with sufficient conviction. Also children born of mixed marriages have increasingly declared themselves Ukrainians (this was noted in a special study).[4] The total Russian population of Kiev has doubled during the period 1926–1959

[3] It should be borne in mind when comparing the data of the Soviet census records with those of the 1897 census, that the latter did not have any questions about national status; the ethnic structure under that census was determined by the mother tongue only. The policy of Russification under the Tsarist rule led to a neglect of the Ukrainian language and its social prestige was lower compared with that of Russian (also of Polish, within specific groups). It was because of the similarity of the Russian and the Ukrainian languages that the ethno-linguistic boundary was by many standards a relative one (a similar indefinity could hardly have occurred in the other non-Slavic peripheries of the Russian Empire, where the Russian language distinctly differed from those spoken by the native population).

[4] V. V. Pokshishevski, Etnicheskiye protsessy v gorodakh SSSR i niekotorie problemy ikh izucheniya (Ethnic processes in cities of the USSR and selected problems of research), *Sovietskaya Etnografiya*, No. 5, 1969.

(i.e., it grew at almost the same rate as the total population of the city), and its proportion has hardly decreased during that time. On the other hand the proportion of the "miscellaneous" nationalities has decreased very rapidly; the Jewish population of Kiev virtually started from nothing after the atrocities of the Nazi occupation; the number of Poles in Kiev has decreased both in relative and absolute figures (due to repatriation and mixed marriages); the numbers of Germans has also decreased in absolute figures.

The data given above[5] illustrate the most extreme examples; they permit, however, a discussion of some definite types of ethnographic relations between urbanization and migration. Thus, the "Tashkent" type of changes in the ethnic composition of population could also be seen for example in other large cities of Central Asia and Kazakhstan characterized by a rapid economic growth (in 1959, Russians constituted 73.2% of the inhabitants of Alma-Ata, 71.8% of Frunze, 52.5% of Ashkhabad, 74.4% of Karaganda, 56.7% of Dzhezkazgan, etc.).

The population influx from other Republics is not so much the outcome of the usantisfactory "quality" of the local population through not being able to satisfy the requirements of a rapidly expanding economy. It is rather due to an absolute shortage of people to fully develop the industrial potential. Such a situation is faced by the Baltic Republics for example. The census of 1970 has recorded an increase in the population influx, particularly to the cities of the Estonian Soviet Socialist Republic. The positive balance of migration to the above cities has been calculated for the period 1959–1970 as 131,600, including 92,500 from beyond Estonian SSR. This latter figures is nearly half (45%) the entire natural increase of the urban population of the republic during the inter-census period.

A rule that can be adopted to describe an ethnographic trend clearly seen throughout the USSR, would run as follows: the influx of the Russian population in cases with a rapid growth of industrialization "exceeds" the pull exerted by the national and ethnic centres on the native population; in cases with a slower economic development, the proportion of the native nationality in the total population of a city may be considerably higher. An interesting relation between the proportions of the native and immigrant population (the latter being mainly Russian) and depending on the size of the city (i.e., total population) occurs in the towns of Union Republics (except the Russian Soviet Federal Socialist Republic) and in the towns of Autonomous Republics incorporated into the Russian Republic. It is not only the capitals, but also the larger cities whose size largely depends on the development of the industry, that rapidly attract their population from outside their republic. It is for this reason that the composition of the population of such cities has a mosaic pattern, with the simultaneous increased proportion of Russians. This proportion may be smaller in medium and small towns. In urban types of settlements, however, many of which form newly established industrial centres, the proportion of Russians may also be rather higher.

The author has locked at the dependence of the ethnic composition on the size of a city for the Lithuanian and the Tadzhik Soviet Socialist Republics.[6] The dependence was fully confirmed. On the other hand the picture thus obtained about a settlement of the urban type has proved more variegated. This proves beyond doubt that they should be considered differently, and those

[5] For particulars see V. V. Pokshishevski, foot note 4.
[6] V. V. Pokshishevski, Etnicheskiye protsessy... (foot note 4).

which form newly established industrial centres should be put into a separate group.

The specific social features of ethnic processes in cities, essential to ethnography, include: a very deep division of social activities that cuts across the national divisions of the population; the variety and the great activity in contacts (personal ones, as well as those between whole professional or social groups); a high level of mutual exchange of information (including national cultural values); the knowledge of two, and sometimes several languages; an increased participation in non-material activities; availability of durable equipment (including household equipment) which tend to equalize the way of life of the various population groups; architectural forms which reduce the possibility of preserving many traditional domestic ethnic features; an absolute prevalence of factory made commodities for meeting the requirements of the population (these commodities sometimes preserve ethnic features; this, however, almost exclusively concerns items of applied art).

One more important feature can be seen in Soviet cities, particularly in those which have become capitals of the Union and Autonomous Republics, centres of Autonomous *Oblasts* or of *Oblasts* within the Union Republics (and it is these cities that form the "officer corps" within the urban network beyond the Russian Federal Soviet Socialist Republic, and in the territories of the Autonomous Republics of the Russian Republic). In these cities one finds special organizations and institutions, whose activities try to develop national forms of socialist culture.

An essential feature of "urban ethnography" in non-socialist countries may be the spatial segregation of racial or ethnic groups, an ethnic discrimination in the labour market, a struggle between languages, and other manifestations of ethnic antagonisms.

Three main ethnic processes characterize our epoch. First, the consolidation of nations, particularly of those involved in the development of the victorious conditions of the Socialist system, and those (in the developing countries which are only passing the initial stages in their integration. Second nations drawing closer to one another and their life paths frequently interweave. Third, the assimilation of minor nations by major nations which are more economically, socially, and culturally advanced.

These three processes are more active in urban areas. The effect of the urban environment, which levels off external ethnic features and is likely to encourage the assimilation, is often accompanied by an opposite trend. This aims at sharpening the ethnic consciousness through the daily opportunities to compare one's "own" culture with others, as represented by other ethnic groups. In the USSR and other Socialist countries this sharpening stimulates creative competition and cooperation between neighbouring national cultures in the cities. It does not oppose a rapprochement of nations since each of them wholly preserves its individuality and can freely manifest its features. In contrast, in capitalist countries such a sharpening of the national consciousness may lead to evergrowing national and ethnic conflicts.

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THE ROLE OF URBAN-INDUSTRIAL AGGLOMERATIONS IN THE SPATIAL-ECONOMIC STRUCTURE OF POLAND

Stanisław Leszczycki, Stanisław Herman and Piotr Eberhardt

The trend towards spatial concentration in the development of manufacturing and services, both under capitalism and socialism, have led to a large increase in the urban population and have greatly affected the urban settlement system. The latter changes account for the generation and development of new towns into integrated settlement systems, which have been called urban systems, agglomerations, conurbations and metropolitan regions.

An essential feature of the spatial-economic structures of contemporary societies is the generation of integrated settlements systems composed of big cities and their surrounding smaller towns and villages (in which, incidentally, the socio-economic functions, the type of building and the occupational structure of the rural population have also changed). These integrated settlements systems, resulting from the processes of socio-economic concentration, constitute new settlement forms characterized by a tendency towards spatial expansion.

In this report the following types of units are distinguished:

— urban-industrial agglomeration,
— central area (central city),
— urbanized area,
— urbanizing area.

The administrative units constituting a central area must fulfill one of these conditions:

— the population density must not be lower than three times the national mean,
— the index of industrial employment per 1000 population must not be lower than twice the national mean.

In delimiting central areas, the principle of territorial contiguity (i.e. the direct neighbourhood of the administrative units which satisfy the adopted criteria) has been abandoned.

In delimiting an urbanized area, the following criteria were used:

— population density must exceed the national mean,
— the proportion of the rural population earning their living outside agriculture must be more than 1.5 times as large as the national mean,
— the proportion of the rural population earning their living in both agricultural and non-agricultural occupations (people with two jobs) must be more than 1.5 times as large as the national mean.

The last two mean values refer to the total rural population. Administrative units in which at least two of the three above factors occur were accepted as urbanized areas. Moreover the urbanized area comprised all towns and settlements unless they had already been included in the central areas.

In delimiting an urbanizing area three criteria were used:

— the population density must exceed half the national mean,

— the proportion of the rural population earning their living in non-agricultural occupations must exceed the national mean,

— the proportion of the rural population earning their living in agricultural and non-agricultural occupations (people with two jobs) must exceed the national mean.

The last two national means refer to the total rural population.

The urban-industrial agglomerations include central areas and urbanized areas; together these two types must follow the condition that the population and the industrial employment must not be lower than one percent of the corresponding national values. The year 1966 was taken as the point of departure, and therefore the population must not be less than 315,000, and the industrial employment not less than 40,000. An exception to this condition is in delimiting the potential agglomerations of Białystok and Lublin when it was assumed that the population of the central area does not exceed more than 0.5% of the national total, and the proportion of industrial employment is over 0.8% of the national volues.

TABLE 1. Area, population and population density in the urban-industrial agglomerations of Poland, 1966

No.	Urban-industrial agglomeration	Area in km²		Population		Population density
		Total	%	Total (,000)	%	per km²
1	Katowice	6,124	1.96	3,032	9.6	495
2	Warsaw	1,893	0.61	1,782	5.6	941
3	Cracow	2,823	0.91	985	3.1	348
4	Łódź	587	0.19	932	2.9	1,586
5	Sudetes	2,641	0.85	722	2.3	273
6	Old-Polish	2,691	0.86	633	2.0	235
7	Gdańsk	510	0.16	618	2.0	1,211
8	Bielsko-Biała	2,564	0.82	553	1.7	216
9	Wroclaw	482	0.16	510	1.6	1,057
10	Poznań	455	0.15	501	1.6	1,099
11	Opole	3,114	1.00	474	1.5	152
12	Bydgoszcz–Toruń	384	0.12	399	1.3	1,037
13	Częstochowa	1,521	0.49	398	1.3	262
14	Szczecin	420	0.114	331	1.0	786
15	Lublin	201	0.06	230	0.7	1,145
16	Białystok	466	0.15	172	0.5	307
All urban-industrial agglomerations		26,893	8.63	12,274	38.9	456
The remaining areas of the country		284,837	91.37	19,278	61.1	68
Poland		311,730	100.00	31,551	100.0	101

Moreover the urbanized areas making up the agglomerations must retain territorial continuity (the administrative units which fulfill the adopted criteria must be in direct neighbourhood). By leaving aside the principle of territorial

contiguity when delimiting the central areas making up the agglomerations, it was possible to distinguish mono- and polycentric patterns.

This method was used to delimit the following sixteen urban-industrial agglomerations and the urbanizing areas surrounding them (in order of decreasing population — see Table 1 and Fig. 1): Katowice (together with the Rybnik Coal District), Warsaw, Cracow, Łódź, Sudetes, Old-Polish, Gdańsk, Bielsko-Biała, Wrocław, Poznań, Opole, Bydgoszcz–Toruń, Częstochowa, Szczecin, Lublin and Białystok.

* * *

The urban-industrial agglomerations were delimited for the first time in 1969 by S. Leszczycki on the basis of the data contained in the GUS (Central Statistical Office) statistics pertaining to industrial districts and urban units. S. Leszczycki delimited then sixteen urban industrial agglomerations which did

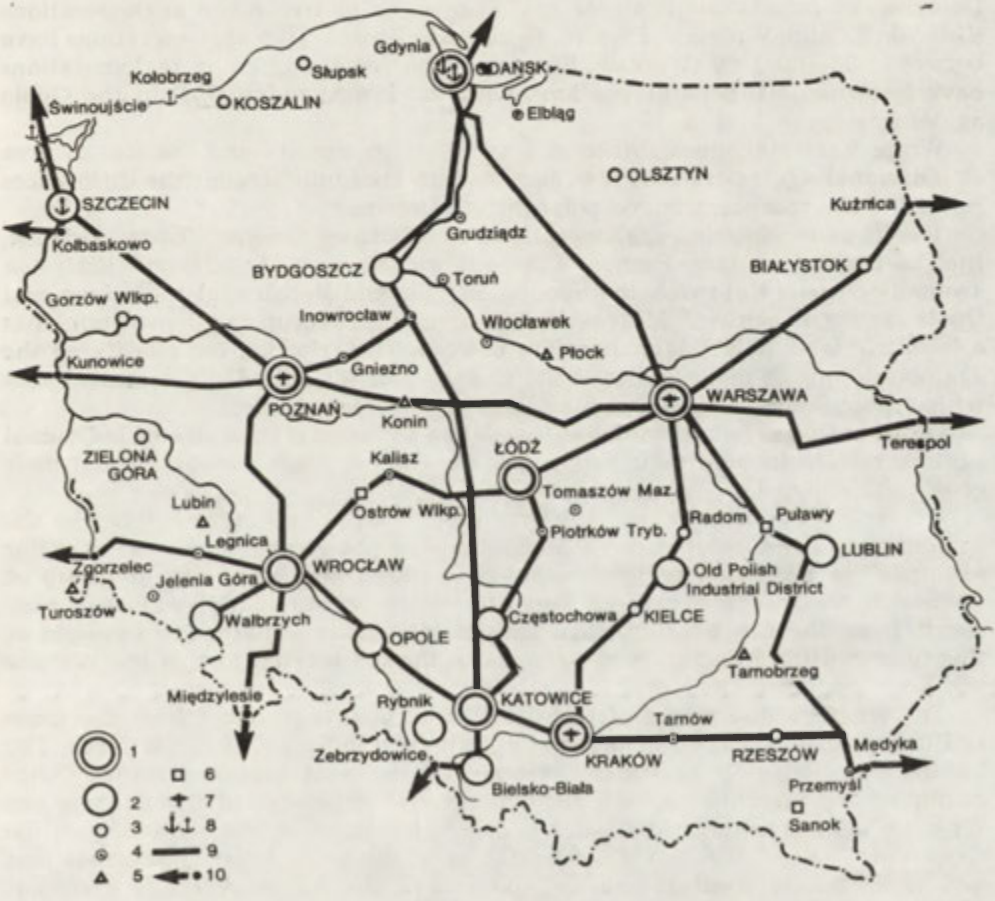

Fig. 2. Main centres of national economy in 1970

1 — main urban and industrial agglomerations, 2 — important urban and industrial agglomerations, 3 — autonomous voivodship capitals and some district towns, 4 — towns with more than 50 thousand inhabitants, 5 — industrial centres on the basis of mineral resources transforming into industrial districts, 6 — industrial centres developing into industrial districts, 7 — international airports, 8 — international seaports, 9 — main transportation lines (on the basis of railroad net), 10 — main boundary crossing points, 11 — state boundaries, 12 — main rivers

non coincide either with 20 industrial districts nor with 10 urban areas (metropolitan areas) as delimited by GUS. He delimited 7 largest agglomerations: Upper Silesian (Katowice), Warsaw, Cracow, Łódź, Wrocław, Poznań, Gdańsk and 9 smaller ones: Bielsko-Biała, Rybnik, Opole, Częstochowa, Bydgoszcz-Toruń, Szczecin, Wałbrzych, Old-Polish and Lublin. (Fig. 1 at the end of the volume).

His later calculations showed that the Rybnik agglomeration should be linked with the Katowice agglomeration, whereas Lublin should be treated only as a potential agglomeration. The Silesia-Cracow-Opole economic macroregion and the economic macroregion situated in central Poland were also delimited at the same time (Leszczycki 1970a, 1971).

The differences in the area and population of the agglomerations account for the great differences in their population densities. The mean density of the sixteen agglomerations is 456 persons per km², which is 4.5 times more than the national mean. The Łódź agglomeration has the highest index (1586). Densities of more than 1000 per km² also occur in five other agglomerations (Gdańsk, Lublin, Wrocław, Poznań, Bydgoszcz–Toruń). Two agglomerations have between 500 and 1000 (Warsaw, Szczecin). The remaining eight agglomerations have less than 500 persons per km², with the lowest index (152) in the Opole agglomeration.

While discussing the number of population, its density and the size of area of individual agglomerations it is necessary to take into account the differences related to the monocentric and polycentric patterns.

The urban-industrial agglomerations of Warsaw, Cracow, Łódź, Gdańsk, Bielsko-Biała, Wrocław, Poznań, Częstochowa, Szczecin, Lublin and Białystok are monocentric; Katowice, the Sudetes and the Old-Polish agglomerations, and Opole are polycentric. Moreover the Bydgoszcz–Toruń agglomeration has a bicentric (or bipolar) agglomeration pattern. The criterion for classifying the agglomerations as monocentric is the existence of a single distinct central area with a population at least twice as large as the second one.

Other essential factors which differentiate the spatial structure of individual agglomerations include their origin, the duration of their formation, and their geographical location.

Regarding the origin of an agglomeration what is important is whether the agglomeration is developing on a production-technological conurbation base (for example the Katowice agglomeration) or through one large city or group of towns. In the two latter cases the differences in the spatial structure may result from the functions fulfilled by the settlement systems (an example of this type of differentiation is to be found in the spatial structure of the Warsaw and Łódź agglomerations).

The length of the period of formation of an agglomeration affects the scope and degree of integration of the spatial units making up a particular area. The Lublin and Białystok agglomerations are examples of incipient forms. Other examples are furnished by the different spatial structures of the Cracow and Wrocław agglomerations; the latter is due to the break in the continuity of the city's development through the devastation of the war. Apart from areas that owe their development to mineral extraction, the influence of geographical situation on the spatial structure of an agglomeration is most conspicuous along the coast.

The indexes of population concentration in urban-industrial agglomerations, discussed above depend on the spatial concentration of industry and services which, in turn, according to the principle of a positive feed-back loop stimulates a further concentration of socio-economic activities. The occupational structure

is the most comprehensive population index of the concentration of man's non-agricultural activities in the agglomerations. In 1966 the mean index of non-agricultural population in the total population of the agglomerations was 75.7%. The highest index, 89.2%, is in the Szczecin agglomeration.

In analysing the occupational structure of the population of the urbanizing areas special attention should be paid to those earning their living both in agricultural and in non-agricultural occupations (called the "dual-occupation" population). In five agglomerations this index exceeds 10% of the occupational structure of population and in Bielsko-Biała it reaches 22%. The index of population earning their living from agriculture is also characteristic in some agglo-

TABLE 2. Industrial employment in the urban-industrial agglomerations of Poland, 1966

No.	Urban-industrial agglomeration	Industrial employment			
		Total	%	Per 1000 population	Per km²
1	Katowice	724,612	19.0	239	118
2	Warsaw	299,369	7.8	168	158
3	Cracow	136,004	3.6	138	48
4	Łódź	263,614	6.9	283	449
5	Sudetes	163,813	4.3	227	62
6	Old-Polish	129,676	3.3	205	48
7	Gdańsk	100,032	2.7	162	196
8	Bielsko-Biała	117,268	3.1	212	46
9	Wrocław	97,789	2.6	192	203
10	Poznań	102,578	2.7	205	225
11	Opole	89,039	2.3	188	28
12	Bydgoszcz–Toruń	89,814	2.3	225	234
13	Częstochowa	89,538	2.3	225	59
14	Szczecin	49,704	1.3	150	118
15	Lublin	40,096	1.0	174	199
16	Białystok	29,673	0.8	172	64
All urban-industrial agglomerations		2,522,619	66.1	205	94
The remaining areas of the country		1,291,293	33.9	67	4
Poland		3,813,912	100.0	121	12

merations. This index does not correlate with the population of the agglomeration. The lowest index is found in the Gdańsk agglomeration (0.4%), and the highest in Opole (13.3%) and Cracow (18.6%).

The urban-industrial agglomerations concentrate more than 54% (10,011,000) of the total non-agricultural population of Poland. For comparison, let us note three indexes of non-agricultural population: 58.6% for the total population of Poland, 75.5% for the urban-industrial agglomerations, and 44% for the remaining areas of Poland (data for 1966; in each case the total population of a given area, including the "dual-occupation" population, has been taken as 100%).

The degree concentration of socio-economic activities in the agglomerations can best be considered by looking at their industrial potential. By using the equivalent national values we can say that the 16 agglomerations, occupying

only 8.6% of the total area, concentrate 66% of the industrial employment and 65% of gross fixed industrial assets, and produce 67.5% of the total output of Polish industry.

The analysis of the concentration of industrial employment (Table 2) shows the Katowice agglomeration in first place; it has 725,000 people employed in industry, which is 19% of the total industrial employment of Poland and 29% of the industrial employment of the 16 agglomerations. Eight agglomerations have 100,000 to 300,000 industrial employees, which is 2.7% and 7.8% of the national total. The lowest index of less than 2.0% is found in the agglomerations of Szczecin, Lublin and Białystok.

Insufficient statistical information precludes a description of tertiary activities, which are significant factors for the development of urban-industrial agglomerations.

At present it is only possible to give exemplary data about the cultural functions concentrated in the agglomerations. All publishing houses, broadcasting and television stations, and all motion picture organizations and 90% of the philharmonic and symphonic orchestras, operas and theatres are concentrated in these areas. The concentration of these institutions differs greatly among these agglomerations. They are mostly concentrated in the agglomerations with the largest populations, and mainly in Warsaw.

An essential feature of urban-industrial agglomerations is the concentration of most of the activities referred to as quaternary, i.e. scientific. Together with the concentration of the cultural institutions this gives these agglomerations the leading role in creating scientific and cultural values of national importance. The following figures illustrate the high concentration of scientific institutions in the agglomerations. In .1970 the sixteen agglomerations had 99% of the research centres, 99% of the people employed in research institutions, and 99% of the scientific libraries. Of the total number of 85 institutions of higher education in Poland, 77 are found in the agglomerations; in the academic year of 1970/71 these institutions employed 98% of all research and didactic workers and accounted for 96% of all students in Poland.

Thus the urban-industrial agglomerations appear to be the principal centres of culture, science, higher education, etc. They make up a polycentric network of three categories of links. The largest ones in this network are Warsaw, Cracow, Wrocław and Poznań. Next in size and importance are Łódź, Gdańsk, Katowice, Toruń, Lublin and Szczecin. The remaining agglomerations and towns of Olsztyn, Rzeszów, Zielona Góra, Koszalin and Słupsk make up the third category of cultural and scientific centres, which are nevertheless of national importance.

The spatial pattern of cultural centres in Poland is a polycentric one. This has resulted from historical developments which could not be overcome by the trend toward centralism during the 20-year period between the two world wars, nor by the privileged position of Warsaw as the national capital in the postwar period. The dominance of Warsaw can still be observed.

Because of the high degree of concentration of demographic, socio-economic and scientific-cultural potentials and the considerable economic strength of the urban-industrial agglomerations, these agglomerations constitute the most important nodes in the country's spatial-economic structure. The trend towards transforming the urban-industrial agglomerations into spatial forms corresponding with the phase of metropolization, as well as the processes of integration between agglomerations, point to an increasing importance for these settlement systems. This is supported by the trends both in Poland and in the highly developed countries. It results from the increasing number of socio-economic pro-

cesses of concentration, and an increase in the population, on a national scale, and from the changes in the spatial forms of these concentrations.

The increasing significance of agglomerations in Poland's spatial-economic structure is attested by their population growth. At this point we give some demographic data for the period 1960–1970. In the area of the sixteen agglomerations the population increased by 1,833,300. (In 1960 there were 11,360,600 in 1966 12,274,000 and in 1970 — 13,193,000). This increased the percentage of the agglomeration population of Poland's total population from 38.1% in 1960 to 40.5% in 1970. Except for the Łódź agglomeration, where the population has not altered, all the agglomerations increased their proportion in the country's total population over the 10 years.

The increase rate in the population in the 1960–1970 decade was 116.1% for the agglomerations and 105.3% for the other areas, for the whole country it was 109.4%. There are considerable differences in the rates of population growth of the particular agglomerations. The lowest rate was in the Łódź agglomeration (77,000—108.7%), and the highest in Białystok (52,200—133.3%). Apart from Białystok, six agglomerations had increase rate of more than double the national average.

In the 10-year period the increase in population in the agglomerations was due to the concentration of 65.2% of the total national increase in the agglomerations. The absolute increases in the particular agglomerations show considerable differences. In the two largest agglomerations (Katowice and Warsaw) the combined increase was more than 600,000; in two others, Cracow and Gdańsk, more than 300,000 and in the remaining twelve agglomerations it totalled about 900,000.

Another measure of the growing significance of the agglomerations is their industrialization in the post-war period. Industrial employment for 1946–1966 was used here as an index. The total increase in employment in the agglomerations was 1,587,000, that is 62% of the total national increase. This increase accounts for the nearly threefold increase in employment in the agglomerations during this period. The highest rates can be seen in the smallest agglomerations whereas the lowest are found in Katowice and Łódź. However, for these two the smallest relative indexes of growth hide very high absolute numbers (Katowice increased by 353,000 employees, Łódź by 123,000).

The role performed by the urban-industrial agglomerations in the structure of the national economy also depends on the functional differentiation of their specialization within the social and territorial division of labour. This specialization is connected either with geographical situation (e.g. specific character of coastal urban-industrial agglomerations, and the specific character of regions that have developed on the basis of the extraction of mineral raw materials), or with historical traditions (e.g. the functions of the capital city), or with specialization in particular socio-economic and scientific-cultural activities.

The concentration of the potentials and differentiation in their specialized functions has led to close functional relations between the agglomerations based on either the principles of cooperation or competition. This is seen in the strong mutual links in information flow, in the role of centres of management of different levels and in the large-scale links established by passenger traffic and commodity flows. Thus another significant element of the socio-economic structure is the transport and communication network that links the agglomerations with each other and connect them to the transit roads through state boundaries by land and sea and to holiday and recreational areas. The problem of connections, especially for individual and large-scale individual traffic, is becoming more important due to man's increasing mobility; they give

rise to distinctly marked ribbons connecting particular centres (nodes) of economic life with each other and with the recreational areas. These ribbons show different levels of investment depending on the size and significance of the nodes they link. The intensity of traffic between the centres also depends on the distances separating them. In this way a spatial nodal-ribbon system is formed by the principal centres and the interconnecting ribbons of transport and communication links. Current trends show that the system constitutes the fundamental framework of the spatial development of the country.

In some cases, the intensity of transport and communication links, the integration processes, and the territorial development of the urban-industrial agglomerations, have already contributed in some cases to the development of larger territorial units which constitute merging agglomerations. A typical example of this phenomenon is the emergence of the Southern Socio-Economic Macroregion, comprising the agglomerations of Katowice, Opole, Częstochowa, Cracow and Bielsko-Biała.

The small distance between urban-industrial agglomerations of Warsaw and Łódź, the specific functions of Warsaw as the capital city, the complementary character of the industrial and cultural functions, and the trends in the spatial growth of these two spatial units — all these factors point to the initial stages of the generation of the Central Socio-Economic Macroregion.

The above two macroregions will be the major centres of the future spatial-economic development of our country. The transport and communication links existing between these two macro-regions resulted in the development of highly invested communication ribbons. These ribbons cross the Old-Polish agglomeration and run through a number of medium-sized towns along the Częstochowa–Koluszki line, thus constituting complementary systems of links in the form of an irregular hexagon with a high intensity of movement, due to the intensive economic and social activity.

To conclude we would like to give a tentative classification of the urban-industrial agglomerations using the following criteria: the development stage, the population expressed as a percentage of Poland's total population, the spatial form, and for monocentric agglomerotions, the degree of population concentration in the central area.

In accordance with the scheme of the changes in the urban settlement network, the following development stages are distinguished: the point stage, corresponding to one compact urban centre, the agglomeration stage, and the stage of metropolization. Within these stages in turn, a complementary distinction has been introduced, involving the percentage of the population of a given agglomeration in the total population of Poland. Two fundamental types of spatial form are distinguished, the monocentric and the polycentric, plus an intermediary form, the bicentric type (Bydgoszcz–Toruń agglomeration). The monocentric agglomerations are additionally divided into three classes depending on the percentage of the population of the central area in the population of the whole agglomeration.

This classification suggests the following conclusions:

(1) Two agglomerations in the initial stage of development (Lublin and Białystok) become monocentric agglomerations with a considerable concentration of population in the central areas.

(2) Four urban-industrial agglomerations (Szczecin, Poznań, Wrocław, Łódź) cover a smaller area and have a high concentration of population; they are monocentric. Although these four spatial units fulfill the adopted criteria for delimiting agglomerations, they are typical examples of concentrated industrial

cities with a poorly developed urbanized hinterland. The processes of integration and urbanization are strongest in the Łódź agglomeration, which has led to a full integration of Zgierz, Aleksandrów, Konstantynów and, to some extent of Pabianice with the city of Łódź.

(3) The largest group (ten) of delimited spatial units are in the agglomeration phase. Their differentiation is due to the number of population and their spatial form. Within this group, five agglomerations are monocentric, three polycentric, and one bicentric.

(4) The only spatial unit in the metropolization phase is the Katowice agglomeration. Its apparent polycentrism is open to dispute because of the high functional and spatial integration of the towns and settlements which form a comprehensive central area. This qualification is due to a division of functions and to a spatial differentiation within the central area.

TABLE 3. A classification of the urban-industrial agglomerations of Poland

Spatial forms Stage and size of spatial development	Monocentric			Bicentric (bipolar)	Polycentric
	with high level of population concentration (more than 90% of population in the central area)	with average level of population concentration (75–99% of population in the central area)	with low level of population concentration (less then 75% of population in the central area)		
1	2	3	4	5	6
Initial point stage with population less than 1% of the national total	Lublin	Białystok			
Advanced point stage with population 1–2% of the national total	Szczecin Foznań Wrocław				
Advanced point stage with population above 2% of the national total	Łódź				
Agglomeration stage with population 1–2% of the national total			Częstochowa, Bydgoszcz Bielsko-Biała, Toruń		Opole
Agglomeration stage with population 2–5% of the national total			Cracow		Gdansk, Old-Polish Agglomeration, Sudetes Agglomeration
Agglomeration stage with population above 5% of the national total		Warsaw			
Metropolization stage with population c. 10% of the national total					Katowice

(5) The monocentric form with a high concentration of population in the central area is found particularly in agglomerations with a compact area and in the point stage.

To complete the data given in Table 3 additional information must be given. The Gdańsk agglomeration can be defined as polycentric but integrated because of the integration of the towns making up its central area according to the criteria adopted by us. Of the three polycentric regions, in addition to Katowice, the Old-Polish agglomeration formed a cross-zone system; in Opole there are very dispersed central areas within the compact system of urbanized areas; in the Sudetes agglomeration, which is ribbon-like in shape, three independent groups of central areas have developed.

The above classification of the development stage and spatial forms illustrates the hypothesis of the coexistence of different stages in current changes in urban systems. Apart from the Katowice agglomeration, which is at the metropolization stage, there are fully developed agglomerations as well as those in their initial stages.

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SOCIAL ASPECTS OF THE SPATIAL ORGANIZATION OF SETTLEMENT SYSTEMS

(The settlement region as a new objective in urban planning)

ZOYA N. YARGINA

The processes of urban agglomeration, the creation of different forms of settlement grouping and of systems of inter-settlement service-exchange, all testify to a new urbanizing system and to a new objective in urban planning, caused by the scientific-technological revolution. To decide what the objective in drawing up plans (and of forecasting) is, one must first work out a socio-urbanistic hypothesis. This will define the categories and parameters of the task. The most important social preconditions for solving this question are changes in the social division of labour and in the system of social values, which are connected with the passage to the second phase of communism. These changes enable us to forecast the development of the different types of inter-settlement links and the trend in the formation of a settlement system.

The further development of the division of labour, the increasing importance of information flow and of exchange (especially the exchange of information) is inevitably linked with an intensification of inter-settlement links and with the formation of important inter-settlement urbanizing elements. These elements include zones of industrial production, scientific and educational complexes, administrative and cultural centres, and recreational areas. The development of links (exchanges) can be found in the growth of commuting, of transport, the more active development of settlements near the central towns of an agglomeration, and so on. Exchange, being one of the more important factors in the development of the economy, is currently widely expanding (quantitatively at least). This can be seen in the modern forms of urbanization. Given that a qualitative improvement in the organization and technology of exchange, and especially in the factors stimulating the growth of this activity, is long-term future task, then one might expect important structural changes in inter-settlement links. One might also except an inrease in the range of these links, a weakening of the centripetal tendencies of urban agglomeration, and the conditions for a more even distribution of population. Even today the development of transport is leading to some deconcentration of population, to an enlargement of the zones of influence of central towns, and to a decentralization of the nucleus of the agglomeration.

In the future we might expect permanent socio-spatial system which take in various types of settlement units. One important difference between these systems and today's urban agglomerations would seem to be a levelling in the condition of population distribution through all the elements of the system (and the subsequent overcoming of the centripetal tendencies in the distribu-

tion of population). A second set of differences are the levelling of social values in both built-up and non-built-up areas, the elimination of the contrast between urban and non-urban areas, and the necessity for an integrated urban-development approach over the whole area of the settlement region.

In the long-term future one can foresee a growth in regional planning through the inclusion of several town-forming or urban problems. Like modern town plans, regional planning must solve the problems of functional zoning, the intensity of the development of an area, the built-up /(non-built-up or natural ratio and so on, in an integrated way. In speaking about the growth of inter-settlement links and the necessity of integrated plans for regional settlements, we will define the objective of future urban planning in general terms. Thus, it is obvious that the conditions of population distribution, natural (environment) factors, the character of production and so on, will lead to various organizational types of settlement system. The regional planning of settlement systems in developed areas will be different from that in unopened or pioneer areas. The developing of areas with harsh environments will lead to the formation of special types of spatial structure.

One obstacle to the formation of the long-term settlement system is the existing network of towns and villages. The role of existing towns as centres of material production, culture, information and human resources, makes it necessary to take into account already formed urban systems and the trends in their development. Thus settlement regions will be formed in areas of varying degrees of development, and correspondingly their directions and goals will vary. In long-developed regions, the traditional integrated approach will be linked with the reorganization and functional ordering of the elements of the settlement process on the basis of maximum utilization of material resources. The dense network of settlements, causing the linking and even overlapping of the spheres of influence of the central towns, will lead to large unbroken areas of settlement in these regions. In other words for areas such as the Baltic, the Central-European Area of the USSR, Donets–Dnieper Region, the Urals and so on, it is necessary to work out long-term plans for the whole area (i.e. for the settlement regions which completely cover it). Two of the important problems in the planning of these regions would seen to be the reorganization of the ways of utilization of an area, and the change in the functional zoning of an area corresponding with new social needs. One of the most important tasks of planning (and at present of forecasting) under such conditions would seem to be finding the built-up/green belt, etc. balance.

Newly developed regions face other problems. There is no lack of territory (compared with more developed regions), and so the problem of green belts and built-up areas is not important. Nor are the problems of reorganizing and rebuilding existing settlement systems found here. Finding the right balance between the demands of urban construction and the problems arising from social structures and processes is easiest during the first stage of developing an area. There is also here another equally important problem; the first towns or groups of towns in newly developed regions cannot immediately achieve the level of social reproduction of existing large towns and agglomerations. To reach this level one needs more time. Thus one must work out special principles and norms of settlement organization in these pioneer regions, which differ from those for urban development in existing settlement systems. Society must provide some sort of subsidy for these newly developing regions. Together with the planning of settlement systems, one must have different forms of settlement in regions with unfavourable natural conditions, and also varying forms of temporary settlement. Temporary settlements, based on the exploitation of

natural resources, can be seen sporadically in Eastern Siberia and Central Asia. The different living conditions found in this type of settlement will always remain. Thus there is the problem of raising the standard of living in these settlements to that in developed regions of the country. In talking about the elimination of the differences in living conditions one must surely evaluate them, since one does not want to stereotype all forms of settlement.

The further differentiation of labour, the creative development of man, and the differentiation and increasing complexity of social structure lead to an increase in the number of areal forms of settlement, accompanied by the elimination of unequal living conditions. The present structure of the forces of production lies at the threshold of an important break through, due to scientific-technological revolution. The settlement system, composed of "independent" towns and villages, is also in this position. The destruction of this "independence" and the creation of inter-settlement links are signs of new features of settlement systems which reflect the processes of the scientific technological revolution. While the level of these links and the degree to which they encompass the settlements units of the country remain small, the main object in urban development is still the individual settlement. The question of large and small towns, and of their optimum size, is a typical theoretical problem of this stage. The creation of suitable settlement systems which would include settlements of various size and type, would allow the greatest exploitation of the advantages of concentration, currently enjoyed only by large towns. It would also avoid the social difficulties associated with a large concentration of population. The problem of choosing between a large and small town must in the long-term give way to the rational organization of the "settlement region" (SR).

The integrated formation of a settlement region, which includes towns and villages of various size, is at the basis of development of the techniques and organization of inter-settlement links (exchanges); it would seem to be an important factor in overcoming the conflict between town and country, and between different types of towns. In analysing the present form of settlement one must consider two related trends. The first is the continued division of labour and the increase in exchange; this leads to a concentration of production and population, and to the integration of settlement units. The second is the revolutionary progress in the techniques of exchange, which give rise to new forms of this concentration. This also creates settlements systems over large areas, where the density of population not only does not increase, but even tends to decrease. The nature of the settlement largely depends on the relation between these two factors. In those cases where the techniques of exchange lag behind the division of labour we have places of population concentration. With the active development of exchange there can be a preferential building up of links and the creation of a more equal distribution of population throughout the system. (One must be aware of those trends which can upset this tendency: local shortages of territory, or particularly, existing town formations).

Whereas today the most often used index is the density of population within a town, in the future one will have to apply it to the whole settlement region (SR). This is true especially of developed regions where the most important long-term task is to achieve the proper balance between built-up areas and the remaining areas (green belts, etc.). The task of intensifying the exploitation of the area of the SR must be seen as one of achieving the maximum agreement between its main zones and elements, and the types of industrial production, social and other activities found in these zones and elements. Only then can one

consider the rationally organized areas of urban centres and zones of recreation or reserves to be intensively and evenly developed. This contrasts with the irrational use of present sub-urban areas.

Can we speak about a basic difference between the future structure of group settlement systems and the structures of existing agglomerations, which would today make it necessary to plan towns with wider boundaries than the current ones? Whereas the concept of group settlement is accepted by most authors today, the problem of structure or the functional organization of settlement systems, is looked at from various points of view.

Above all, one should define the functional elements in the organization of the SR. When talking about the functional organization of a town we use the concept of a "functional zone" (zones of housing, industry, recreation, etc.). In regional planning the basic element is the settlement unit, and above all, the town. (In this respect the terms "buffer" zone and "inter-urban" territories automatically become second-order objectives). In the future it will be necessary to apply the concept of functional zoning to plans concerned with the whole area of the SR. This division into functional zones does not deny compact settlement units (town or village). It is important to emphasize that a characteristic of the period of the scientific-technological revolution is the appearance of urban systems on a higher level than towns. These systems should not be viewed simply as the sum of individual urban settlements. They need a single integrated treatment over their whole area, especially a uniform functional zoning, and not too much emphasis on their central towns.

The optimization of the functional structure of future settlement units is connected with two important problems. First, areal decisions should consider the different kinds of man's activity. Agricultural and industrial work, trade and recreation, for example, should all have their own areal organization, which reflects the internal over and the technology of the type of activity. Because of the different requirements of areal organization one should adopt a different approach in making decisions about each element of settlement. The second problem, which defines the effectiveness of urban development decisions, is the organization of links between the different functional elements; between industrial productions and scientific centres, science and education, between various types of services, and finally, between places of living and centres of social activity. Thus the necessity for integration, and for "focussing" the various functions. During the building of each functional system this will inevitably lead to a need for "optimization".

The influence of this second factor in working out the system completely depends on the technical level of the links. At present the organization of groups of settlement systems is treated as a hierarchical structure. This structure, analogous to the stepped system in the organization of urban living zones, assumes as a basic principle of the distribution of population — the proportion of towns according to size, or more precisely the level of integration of the conditions of social reproduction (this is analogous to the level of services in living areas). The hierarchical arrangement of systems of settlements, and the existence of separate plan for the towns in this system, are typical of the first stage in the formation of such systems. Against the stability of present hierarchical systems, their "crudeness" beckons a second principle of the functional organization of territory. This is the creation of organically superimposed systems of dwelling, social centres, and places of work. In contrast to the hierarchical principle, where links between the different town-forming or urbanizing elements (dwellings, work, and services) are indicators of optimalization, the "network" organization carries the task of optimizing each system

separately (the various service systems, centres of work and other centres of social activity) and allowing their unrestrained distribution and "imposition" in a unified system of settlement. Under the hierarchical principle the optimum parameters of each system are directly "subordinate" to the territorial principle of their distribution, to the task of demographic equilibrium, to the integrated services, and to the balance of labour. The organization of the network structure represent other approaches: it optimizes each system, the question of links remains open, but each case is a function of the sum of the separate areal systems — dwelling, labour, services and recreation.

Whereas the main consideration in the hierarchical structure is the optimization of links to "dwelling places as centres of gravity", the network structure's optimization of each sphere of social activity is established outside the links between these spheres. In all these cases one essential factors is excluded from the discussion. Both the parameters which have been given must be optimized: bearing in mind the organizational requirements of the various social processes, it is important to define the most effective forms of link between them, and also to spatially strengthen these links. An integrated consideration of these factors will lead to the formation of a functionally differentiated settlement network, whose separate elements will depend on the functional complex. Instead of autonomous, independent, well known types of settlements, settlement units will appear in agreement with accepted principles, which will be differentiated by function and areal organization, and functionally linked into a unified system.

As we have pointed out, an analysis of such a functional approach is required not only for towns, but for the whole area of the SR. The basic principle of the functional zoning of a town, i.e., the division of its area into zones of material production and non-production, cannot be applied to the organization of a region. It is already necessary to study the problem of zoning in the SR in agreement with the differentiated social functions of future society. At present it is difficult to detail functional-planning schemes for similar SR's. The agreement of the SR's functional organization with the future division of labour and structure of social activity is an important proposition. In the structure of the SR, along with the zones of industrial production (formed as in traditional industrial towns, and as in the new forms of spatial organization) we find zones of learning, administration, education, agriculture, and finally zones of recreation. The differentiation and co-operation of the various types of activity lead to the formation of polyfunctional zones with different combinations between the city-forming factors. This will not lead, however, to the universal establishment of town-building systems. One might expect that future integrated functions for spatial organization will be as permanent and clearly defined as ones sees in todays industrial towns, resorts, cultural and scientific centres, etc.

The features of the style of life, which are largely defined by the type of labour, must inevitably affect the structure of the dwelling zones, and the dwellings themselves. Even when future SR's have a developed system of communications, a "link" between places of home and work must be kept open. The development of communications physically widens the concept of the integrated production-dwelling region to the size of large settlement zones (about the size of whole towns). However the links between industrial complexes and their neighbouring dwelling areas are not inflexible. Rather, we have zones of influence similar to centres of social activity; their boundaries will overlap and lose their clarity. However the specific conditions of labour and style of life require their own forms of spatial expression. These spatial forms should allow the most effective organization of a given complex of social functions. The

question of the structure of dwelling areas will cease being a single undivided one. The different functional zones of the SR will need separate attention.

When accepting today's predictions about the functional zones of the future SR's, it is important to uncertain the nature of the processes of their formation. Industry will still be the main city-forming factor in the near future. Technological improvement is a feature of the development of industrial production; this brings production and dwelling nearer, forming the productional-dwelling region. The conditions of the organization of some types of production, the automation of some processes and the development of transport help create large industrial zones far from housing areas and located in the SR's so as to be specialized productional areas of regional importance. Another trend which has greatly increased in recent years, is the formation of centres of learning (often connected with centres of education, industrial complexes, etc.). Undoubtedly, as the role of learning as a direct productional force in society increases, this trend towards centres of learning will also increase. Agricultural zones are organic components of the SR; the organization of settlements in these zones must be integrally treated along with the other areas of the SR. The separate treatment of agricultural zones is still tied up with the existence of differences between agricultural and industrial production. One can already detect the trend towards an administrative zone and cultural centre in the SR. The role of this sort of centre is fulfilled by the central part of the large town. However because the influence of this centre is spreading beyond the town, one must investigate and plan the centre as an element of the system as a whole. Finally, zones of recreation and reserves will be important in the future; they must not be seen only as protected areas for building or for exploitation which brings no economic advantages to the country. To the country, their social value will continue to growth, due to the increase in the role of conditions of population reproduction and the increasing lack of these types of territory. If the expansion of the built-up area at the expense of the non-built-up or natural areas is inevitable, then in the future the recultivation of "natural" areas by limiting and intensifying the use of built-up land, will nevertheless be an important task.

Thus the settlement region expresses many social processes and serves as the environment for social development. There are still many important tasks to be resolved in the way to creating new planned units. These include: defining the parameters of the SR, defining the SR's optimum composition and distribution of its elements; detailing the organization of settlement in old and newly-developed regions, for the various natural-climatic zones of the country, and so on. However, it is already obvious that accepting this new planned unit is an important step in the organization and planning of the process of the scientific-technological revolution.

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METHODS OF ANALYSING INTER-REGIONAL MIGRATION IN THE USSR IN RELATION TO URBANIZATION PROCESSES

Rudolf V. Tatyevosov

Urbanization is a process characterized by rapidly developing forms of urban life, which contribute to the mastering of the territories of this or that area. "A uniform social culture ... by reducing the differences between town and country"[1] at present time brought about by scientific-technical progress is going on at an increasing pace.

The never ending increase in the urban population, as the basic quantitative index of urbanization, can be seen in every country and it equally applies for the USSR.

The relation between urbanization processes and population migration is complex, and has regional peculiarities.

Migration exists in all the historical stages of societal development. However there are variations in the essence and the forms of migration in these various stages. The historical character of migration is that it had distinct class characteristics in an antagonistic society, which were gradually eroded after the socialist revolution. The overall level of migration in society has a historically changing value corresponding to changes in the forms and goals in planning migration.

Both the way in which social life is carried on and the mechanism of migration in society are becomming more complex. T. I. Zaslavskaya[2] distinguishes three basic functions of population migration: the acceleration, redistributive and selective functions. All three are independent, but at the same time are dialectically linked with each other.

The changes brought about by migration in these, and other social processes, are the object of research of various social sciences: economics, sociology, demography, economic geography, ethnography and others. These sciences, which try to confirm and make general conclusions about various scientific hypotheses, discover and extend our knowledge about the processes of migration, from their different standpoints.

The rapid rise in scientific and technological process, so typical of our time, contributes to the growth of the migrational mobility of population. The role of migration in present day society is increasing every year.

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[1] J. Ziółkowski, Sotsiologicheskiye problemy v territorialno-ekonomicheskom razvitii strany (Sociological problems of regional development), *Trudy Kom. po delam Territ.-Ekonom. Razvitiya Strany PAN*, 16, Warszawa 1967 (in English: Studies, Committee for Space Economy and Regional Planning of the Polish Academy of Sciences, 19, Warszawa 1968), pp. 183–200.

[2] *Migratsia sel'skovo naseleniya* (Vilage migration), T. I. Zaslavskaya (ed.), Moskva 1970.

The absolute level of migration in the USRR is currently higher than in all times (not including the war years). More than 10 million people annually change their permanent dwelling place. Thus from only 1962 to 1968 the number of migrants to urban settlements in the USSR totalled about 1/4 of the population of the entire country.

The annual average increase in the number of migrants to urban settlements was 1.4%, although for some years there is a decrease over the previous year (Table 1).

TABLE 1. Numbers of migrants to urban settlements in the USSR compared with the 1962 level (in %) (Migrants from other urban areas and rural settlements)

Year	1962	1963	1964	1965	1966	1967	1968
% %	100	101.3	97.0	100.7	106.7	108.3	119.2

The preliminary summary of the 1970 population census, published in the press, indicates the size of the results of the processes of migration. The total urban population of the USRR increased by 36 million over an eleven-year period. The increase due to the natural growth of urban population was 14.6 million, due to the creation of new urban areas — 5 million, and due to the result of migration from the village to town, the increase was 16.4 million. Thus the proportion of population growth in urban areas as the result of migration in 1959–1969 was 45.5%, and the average annual figure for rural migrants was more than 1.5 million. The movement of rural population to the towns is related to the large increase in industrial production, and was possible thanks to the increased level of mechanization and raising of labour productivity in socialist agriculture (*Izvestiya* No. 93, 18 April 1970).

TABLE 2. The growth of urban population in the USRR (in millions)

Period Elements of growth	1926–1938	1939–1958	1959–1969	1926–1970 (approximation)
Natural increase	5.3	6.9–7.9	14.6	27–28
Migration	18.7	24.0–25.0	16.4	59–60
Administrative changes (creation of new urban areas)	5.8	6.7	5.0	18–19
Totals	29.8	37.6–39.6	36.0	104–107
Annual average increase in migration (millions)	1.4	1.2	1.5	1.4
Proportion of migration in the total increase (in %)	63.1	63.2	45.5	57.0

Source: *Vestnik Statistiki*, No. 7, 1965, pp. 16–21 and *Izvestiya*, No. 93, 18 April, 1970.

Taken for the whole country this is, of course, a positive phenomenon. But one should not forget the regional differentiation of this process. In certain regions of the country, the movement from villages to towns outstrips the creation of the necessary socio-economic conditions, and has restrictive influence both on the development of agriculture and the proportional growth of towns.

From Table 2 one can see that the main element in the growth of urban population is migration and that the average annual figure from 1959–1969 is greater than in the preceeding period.

If one divides the country into two regions — East and West, and includes in the "east" Western and Eastern Siberia, the Far East, Kazakhstan and Central Asia, then one finds that the rate of movement to urban settlements in the Estern part of the USRR in 1968 was 1.5 times greater in the Western part. Migration alone accounted for over 2.5 million of the total increase in urban population, for the period between the 1959 and 1970 censuses, in the Eastern USSR.

Corresponding with the general increase in the urban population of the USRR is the increase in the share of those migrating from the towns. In 1962 53% of the movement to the towns was made up of migrants from other towns, in 1967 it was 55%. The proportions from rural settlements were 37% and 36% respectively.[3] Rural migrants, in contrast to urban migrants, usually move to towns in their own or neighbouring district. Therefore the increased percentage of urban migrants in the total movement is evidence of an increase in the distances of migration movements.

TABLE 3. The effectiveness of the process of urbanization (based on an analysis of the two-way migrations movement between town and country) (figures in %)

USSR Republics	Effectiveness of intra-republican migration			Effectiveness of inter-republican migration		
	1962	1965	1967	1962	1965	1967
Lithuania	52.1	50.3	57.5	38.6	53.0	55.7
Byelorussia	48.6	51.7	53.6	36.6	36.2	43.7
Georgia	49.4	58.8	52.5	16.0	17.8	23.7
Armenia	45.5	51.1	61.4	37.8	43.3	49.8
Azerbaidzhan	42.3	39.9	35.8	24.0	22.1	4.2
Latvia	38.0	35.7	28.6	42.3	51.0	32.5
Turkmenistan	32.0	22.6	20.4	17.8	15.7	8.0
Ukraine	29.9	34.8	35.1	27.2	41.1	39.0
RSFSR	29.1	36.0	34.4	19.6	19.5	21.8
Moldavia	28.5	41.7	41.8	29.0	44.6	37.9
Uzbekistan	22.7	28.6	34.7	38.7	41.2	32.9
Estonia	24.7	19.2	16.1	35.9	33.1	22.6
Kirgizia	21.9	23.0	22.2	29.8	36.2	24.0
Tadzhikistan	19.5	19.2	13.5	30.2	37.6	19.3
Kazakhstan	16.9	23.9	27.7	30.2	28.7	25.2

To characterize the processes of urbanization in the USRR, the author used the index of migration effectiveness suggested by the Polish geographer W. Borejko.[4] This index represents the ratio of the balance of migration to gross migration (sum of outflow and inflow). The calculation of this index for the Union Republics for inter and intra-republican movements, is given in Table 3.

A positive value for this index is the general feature of both types of migration in all the Republics for the period investigated.

The effectiveness of intra-republican migration from the village to the town is highest in Lithuania, Byelorussia, Georgia and Armenia, where every

[3] The remaining 10% and 9% did not indicate where they formerly lived.

[4] W. Borejko, Study on effectiveness of migrations, *Geographia Polonica*, 14, Warszawa 1968.

second migrant from villages in his own republic becomes a town dweller. Estonia and Tadzhikistan have the lowest migration effectiveness. At the same time the index of inter-republican migration in Byelorussia, Armenia, the Ukraine, RSFSR, Moldavia, Uzbekistan and Kazakhstan was much higher in 1967 than in the previous five-year period.

The contemporary map of migration is a complex one. There are clear differences in the intensity and scale of migration in the various *oblasts*. However, a general feature in all the districts is the diverse geographical character of the links between inter-regional and inter-*oblast* migration. This has led to an ever-increasing investigation of these population links.

The distances of migrations between territorial units, and the effect of the direction and size of movement, characterize various socio-economic links and the level of development of the territorial units. The geometry of the geographical space of migration processes, which is the result of the geometry of economic, social and physical space helps to define the regional features

TABLE 4. Average distance travelled by migrants to urban settlements, according to the economic regions of the USSR in 1966

Region	Average distance travelled (km)	Compared with USSR average (= 100) in %
1. Pri-Baltic	592	45
2. Byelorussia	788	60
3. S. W. Ukraine	832	63
4. Donets–Pridneprovsk region of Ukraine	902	68
5. Urals	971	74
6. Transcaucasian		
7. Volga–Vyatka	1058	80
8. Central	1069	81
9. Moldavia	1073	82
10. Volga	1121	85
11. North-West	1122	85
12. Southern Ukraine	1132	86
13. Central chernozem	1301	98
14. W. Siberia	1310	99
15. N. Caucasia	1536	117
16. Kazakhstan	1581	120
17. Central Asia	1843	140
18. E. Siberia	1941	147
19. Far East	3865	293
20. USSR (average)	1317	100

of urbanization. Inter-regional migrational movements represent only one type of inter-regional link. Although inter-regional migrations do not have the same demographic and socio-economic characteristics, the empirical analysis can establish several important trends. The trends worked out in this way usually have a cognitive value. They do not yet permit us to estimate the relative effectiveness of the various trends or causes, which themselves determine the directional type of migration system. However, by indentifying the spatial trends in the migration processes, we might be able to identify its mechanisms.

An investigation of the factor of distance of migration for the Economic Regions of the USSR showed that the relation between size and distance can be well represented by a hyperbolic curve of the type: $y = a + bx^{-1}$. The distance and size of migration varies among the Economic Regions. Table 4 gives the mean values of the distance travelled by migrants to the towns, for each Economic Region. The complex internal structure of migration movements makes it very difficult to analyse the migration flow. The structure of this phenomenon has numerous elements, each having a definite influence on the characteristics of the urbanization processes. The problem is not only the number of elements involved, but equally one of distinguishing their nature. Migration represents a certain combination of economic, social, psychological, ideological, logical and other elements. This phenomenon is so intimately bound up with other phenomena that it is impossible to investigate one aspect without previously having investigated all the other aspects. Therefore the use of migrational models cap help to develop our knowledge of this process.

The existence of various groups of factors each of which influences the migration of population and of the labour force in a different way, does not allow us to build just a single model of migration. However one can build a model for each factor in migration.

One can approach the problem in two ways:

(1) To formalize a logical model of utility functions with estimated applicability to the population (or defined age/sex groups) of various points and areas which corresponds to the images of these territories formed by these populations, and mathematically to simulate the actual process of formation of this utility functions.

(2) To consider migration flows, and also particular groups of migrants (by age/sex, profession, qualification, etc.) as "black boxes", not analysing the internal structure of the process of choosing the destination; by migrants; one therefore compares only the exit and entrance in each "black box". Some scientific tests on the technical methods of building prediction models of the migration of population and labour force have already been done. These include the use of Markov chains, gravitational models, and models describing the behaviour of migrants.

However an essential shortcoming of the methods just mentioned is the limited number of factors they take into account. At present, both in the USRR and elsewhere, various approaches to constructing models of migrations are being worked out, using complex methods of analysis which embroid a wide variety of factors. Above all, these are studies of the conditions and factors favouring migration. These include the problems of the statistical process of migration on the one hand, and predictions of the condition of the ruling element of this process on the other.

The basic condition for the further development of this type of investigation is the compilation of information about the reasons for migrating, which would allow one to express quantitatively the values of each of the factors involved.

Various combinations of multi-variant methods of analysis, for example, regression with factors or components analysis, are already being used in practical scientific investigations. This permits a deeper analysis and is most effective when one needs greater reliability and accuracy in predicting migration process, and following on from this, the possible regional changes in the processes of urbanization.

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AN ANALYSIS OF THE TYPES OF SPATIAL DISTRIBUTION OF TOWNS

Zbyszko Chojnicki and Teresa Czyż

An analysis of the distribution of geographical objects in space is an important step in the generalization procedures of economic geography, since the purpose of this analysis is to explain the occurrence and variation of spatial patterns. Such generalizations are codetermined by multi-variate conditions; hence they are as a rule of an approximate character, and therefore the researcher's principal effort must focus on increasing the accuracy of the approximations. The formulation of generalizations is based upon hypotheses, i.e. tentative solutions that have to be tested. A hypothesis with a high level of confirmation may be included in the theory. The formulation and systematic testing of hypotheses is thus an indispensable step in the generalization procedure.

Recent years have witnessed important advances in this approach, mainly due to the construction of mathematical models of the different spatial patterns which contain definite assumptions about the processes that govern the patterns rather than mere statistical description. The principal methodological problem here is to find models that identify the processes governing the distribution of the objects studied. Stochastic models have proved particularly useful in explaining the distribution and changes in the spatial patterns of human activities.

Such models can be developed by making certain assumptions concerning the mathematical processes that generate some types of probability distributions. These mathematical processes may in some cases refer directly to the processes that occur in reality. Thus a number of probability distributions can be employed as models of geographical processes. The Poisson distribution is among others particularly useful for the analysis of the spatial distribution of points. It occurs in various forms depending on the concrete phenomena to which it may be applied. If a set of events or objects is randomly distributed in space (or time), the probability of an event or object occurring in any part of that area (or in any time interval) is defined by the Poisson distribution.

J. Coleman (1964, p. 291) states, that "... the Poisson process is appropriate to social phenomena because it constitutes a rational model whose assumptions can mirror our assumptions about actual phenomena". The usefulness of the Poisson process in the analysis of social processes is mainly due to the assumptions on which it is based. Firstly, it describes a certain number of elements (or proportions) and events. In this case, therefore, it is not necessary to perform measurements of the values of continuous variables, which occur very rarely in the social sciences anyway. Secondly, the phenomena described by the Poisson distribution are much more continuous in time (and space) than, say, these

described by the binomial distribution, which is more of a description of series of discrete phenomena. Hence the considerable usefulness of the Poisson distribution in studies of spatial distribution; it opens up perspectives for the development of "genetic probability" as the fundamental language for discussing different geographical forms.

The Poisson distribution and other related distributions have been employed as models in a number of mathematical representations in analyses of spatial patterns. These compare the observed pattern with the theoretical one generated by such distributions, and allow measurement of deviations from the particular random processes. These methods include for example D. Harvey's (1966) quadratic sampling, the measures of contiguity of M. Dacey (1965) and A. Cliff (1968), the method of the nearest neighbour of M. Dacey (1962), and A. Getis' (1967) sequence analysis.

The employment of these methods in geographical analyses shows how useful they may be in constructing and testing geographical hypotheses. In studies in settlement geography, the construction and testing of hypotheses through stochastic models involves mainly the description and analysis of the spatial distributions representing patterns of settlements location.[1] The present study is devoted to such an analysis of the spatial distribution of towns and cities using the nearest neighbour method. This method, devised by I. Matui (1932) in his classical study utilizing the Poisson distribution, was later developed by P. J. Clark and F. C. Evans (1954) in the field of plant ecology, and by M. Dacey (1960, 1962) and by J. V. Medvedkov (1967) in settlement geography.

Hypotheses concerning the form of the distribution of the particular points of the settlements network are based on empirical data or theoretical premises. In the former case hypotheses are formulated on the strength of observations, i.e., of a description made in terms of numerical characteristics or maps; this is particularly difficult when many variables are involved. In the latter case, theoretical premises may be derived from different theories. The classical model of constructing and testing hypotheses relating to the spatial distribution of towns is usually taken as Christaller's theory of central places (1933).

Christaller was the first to attempt the construction of a theoretical model of the distribution of towns. He tried to explain the location pattern of towns in terms of the functions performed by the individual towns on behalf of their surrounding areas. The theory of central places, which Christaller derived from an analysis of the market reach of commodities and services, by assuming that all constituents of the populated area can be supplied in terms of the smallest possible number of central settlements, is subject to geometrical laws and constitutes a hexagonal lattice. The deviations from the ideal pattern, based on the principle of supply, account for two further principles — those of communication and administration. Christaller's theory was severely criticized for its statical approach to the problem, and for the narrowly model-oriented assumptions which saw the spatial order of economic phenomena dependent only on some service functions.

The criticism of Christaller's theory need not detain us here, but it may be remarked that the picture of the spatial order furnished by this theory is only indirectly reflected in reality. This is presumably due to the predominantly hypothetical and deductive character of the theory. Hence its laws can explain reality only to the extent to which its model premises are realized in it. Apart from this however, it is to the theory of central places that we owe the develop-

[1] The operational definition of the pattern of distribution (location) of settlements treats them as a set of material points over a definite area.

ment of a rational model of the spatial distribution of towns which may also follow from other premises. The recognition of that order represented by the hexagonal lattice is not in itself a direct test of Christaller's theory, yet it casts some light upon the nature of the processes governing the actual order in geographical space, represented by a pattern which may be regular (hexagonal), random or clustered.

To identify a distributional pattern of towns as a definite type, it would seem promising to start by identifying randomness in the distribution of points on a plane, using the nearest neighbour distance technique.[2]

An alternative approach to the description of point patterns is Dacey's regional method of analysis of the nearest neighbour. The mathematical description of this method is contained in the papers of M. Dacey (1960, 1962), M. Dacey and T. Tung (1962). This method is used with increasing frequency in geographical studies of point patterns.

Our empirical study also illustrates, the use of the nearest neighbour method in describing properties of distribution of Polish towns both in different spatial terms and for different categories of towns, namely for three types of distributions:

(1) for *poviat* towns on the national scale,
(2) for *poviat* towns on the voivodship scale,
(3) for all towns of the Poznań voivodship.

The change of spatial scale and of the categories of towns was intended to detail the specific character of the distribution.

TABLE 1. Nearest neighbour statistics for the set of *poviat* towns of Poland

Sector	Observed	Mean of distribution which is			Ratio of
k	mean	hexagonal	random	clustered	randomness
	d_{1k}	E_h	$E_{rk/6}$	E_c	R_k
1	20.5	38.05	17.85	1.0	1.148
2	26.3	38.05	28.08	1.0	0.937
3	32.6	38.05	37.15	1.0	0.851
4	37.1	38.05	46.55	1.0	0.797
5	43.0	38.05	57.76	1.0	0.744
6	53.1	38.05	75.03	1.0	0.708
		D	D	D	R
		27.2	26.8	88.0	0.806

The analysis of the *poviat* towns for the whole of Poland comprised 264 towns with a density of 0.0008 per 1 km^2. Their mean nearest neighbour distance is 20.5 km, and the mean 6-sectoral distance, 35.2 km. The results of measurements and calculations, that is the actual mean values and the mean values of the hexagonal and the random and the clustered distributions, make it possible both to analyse the spatial distribution of points and to test the hypothesis that the towns constitute a hexagonal pattern rather than either of the two alternative random or the clustered patterns.[3] The mean values indicate that

[2] J. O. Abiodun (1967) used factor analysis to test Christaller's model of central places. She showed that the distribution of the centres of the particular orders in the regional system of the Ijebu Province (Nigeria) is on the whole in accordance with Christaller's model for $k = 3$.

[3] The random distribution of points on a plane is identified by the set of mean theoretical regional distances to the neighbours generated from the Poisson distribution.

the observed pattern is neither fully hexagonal, random or clustered, because the sets of mean observed and mean expected values do not exactly coincide with each other (Table 1).

To provide a basic test for stating which of the three theoretical patterns best fits the actual one, let us assume that the best agreement between the observed and the theoretical patterns is when the differences between the corresponding mean values are smallest; this can be expressed by the formula:

$$D^2 = \sum_{k=1}^{k=K} [d_{tk} - E_k]^2$$

where E_k is the expected (theoretical) value for sector k. In the above analysis the value D is smallest for the random pattern (26.8); this enables us to reject the hypothesis that the *poviat* towns in Poland constitute a hexagonal pattern. The total ratio of randomness amounts to 0.806. The ratios of randomness for the individual sectors decrease with the growth of k (1.148–0.708), which suggests that the first neighbours are more uniformly distributed than the more distant ones (the value of $R = 1.148$ suggesting a trend towards a hexagonal distribution).

TABLE 2. Nearest neighbour statistics for the *poviat* towns of the voivodships

Voivodship	Number of towns	Density of towns	Observed mean sectoral distance	Expected mean sectoral distance in the random distribution	Ratio of randomness
Białystok	8	0.00094	42.1	40.8	1.032
Bydgoszcz	21	0.00106	35.5	39.5	0.899
Gdańsk	8	0.00106	34.2	38.3	0.893
Katowice	22	0.00275	21.1	23.5	0.895
Kielce	21	0.00108	35.6	38.3	0.930
Koszalin	9	0.00072	42.8	45.4	0.943
Cracow	12	0.00139	30.3	33.1	0.915
Lublin	14	0.00088	39.8	42.2	0.944
Łódź	20	0.00115	35.1	37.1	0.946
Olsztyn	14	0.00844	41.4	42.2	0.982
Opole	10	0.00142	31.9	33.2	0.966
Poznań	30	0.00111	36.2	37.1	0.971
Rzeszów	13	0.00168	32.1	29.9	1.071
Szczecin	5	0.00098	37.4	39.5	0.948
Warsaw	29	0.00101	37.1	39.5	0.937
Wrocław	16	0.00129	31.1	34.9	0.890
Zielona Góra	12	0.00113	35.6	37.1	0.958

The distribution of *poviat* towns in the voivodships show ratios of randomness between 1.071 and 0.890, plus the lowest values of the criterion D for the random distribution, which suggests that the distribution of towns on this scale is also random (Table 2). The ratios of randomness for the voivodships show some differentiation, but voivodships tending toward the hexagonal pattern (those of Rzeszów and Białystok) can nevertheless be distinguished from those

tending toward the clustered pattern (Katowice, Gdańsk and Wrocław) (Fig. 1). It must be stressed though, that the ratios of randomness for the first sector are as a rule relatively high (the maximum being reached in the Szczecin voivodship — 1.469) and that the ratio drops below 1 (0.947) only in the case of the Katowice voivodship.

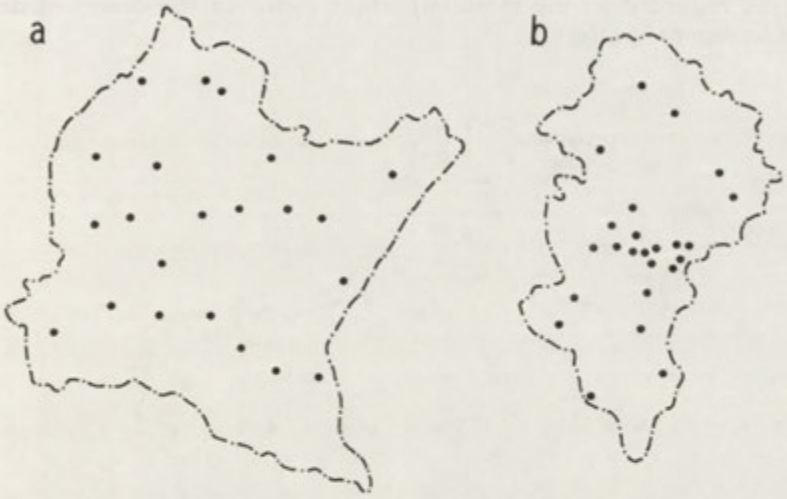

Fig. 1. a — Rzeszów voivodship, 1 b — Katowice voivodship

If the distribution of towns is considered to be a result of the effects of different socio-economic, physico-geographic and other factors, the ideal theoretical distribution is treated as a background and setting for the empirical distri-

TABLE 3. Correlation between the ratio of randomness and the socio-economic variables

Variable	Pearson correlation coefficient
Population density per 1 km²	— 0.4319
Share of urban in total population (%)	— 0.4658
Value of agricultural output per 100 ha of agricultural land	— 0.5372
Industrial employment per 100 km²	— 0.8818
Public roads per 100 km²	— 0.5479

bution. Interpretations of deviations from the uniform distribution which can be seen in the various deviations and distortions is based upon an analysis of the correlations between the value of the ratio R and the socio-economic variables (Table 3).

Ratio of randomness shows a very good negative correlation with the feature "industrial employment per 100 km²" (— 0.88), which is regarded as statistically significant at the $\alpha = 0.01$ level. The value of the coefficient of determination suggests that this variable explains 77% of the variation of the ratio of randomness (as calculated for 17 voivodships). Thus the observed distribution of

towns is conditioned by industrial employment, an important factor in the formation of the clustered pattern (the voivodship of Katowice being one example) The remaining variables of population density, urban population, agricultural output and road network density, are also negatively correlated with the ratio of randomness, though not significantly. Since the analysed factors constitute a group of variables with the closest possible links, the degree of industrialization can be regarded as the most important factor in the observed deviations from the hexagonal pattern.

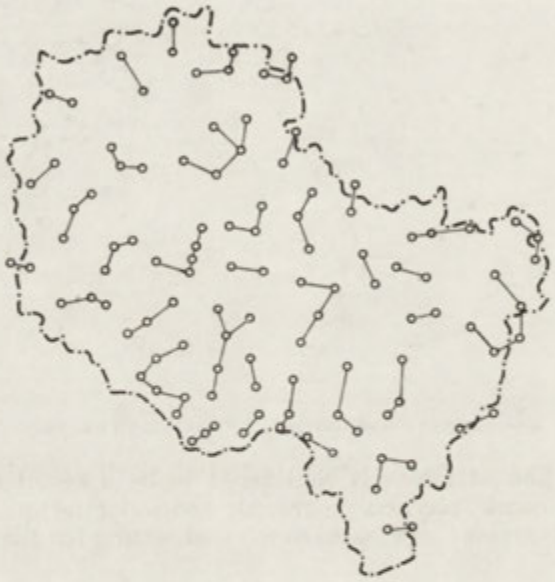

Fig. 2. Poznań voivodship

The observed distances of the towns of the Poznań voivodship are between 4.0 and 50.1 km. The towns exhibit no tendency to cluster, the most frequent form being isolated 2–3-element subsets (Fig. 2). The mean regional nearest neighbour distances are between 11.1 and 30.0 km, increasing systematically in each sector by 3 km except the last, when the change was 6.6 km.

The observed distances to the first nearest neighbour for the set of 102 towns show no correlation (correlation coefficient 0.07) with the population number. Thus the distribution of towns in the Poznań voivodship cannot be explained by this factor (as done by E. N. Thomas, 1961 and J. V. Medvedkov, 1963).

The analysis of the relation between the type of town, defined on the basis of the population's occupational structure, and its nearest neighbour distance also produced unsatisfactory results. No regularities were found in the increase or decrease of the distance to the nearest neighbour depending on the function of the town. However, the relatively small mean distances to the nearest neighbour for the agricultural towns (10.5 km), and the relatively large ones for service and industrial-service towns (13.2 and 14.5 km) were found. Presumably, if we used another method using the proportions of the exogenous group to define the specialization of functions we would get different results, confirm-

ing the hypothesis that the trend toward specialization of functions is inversely proportional to the distance to other urban centres.

The ratio of randomness is 0.971, which with the smallest value D for the random distribution, indicates a random pattern in towns of the Poznań voivodship (Table 4).

TABLE 4. Nearest neighbour statistics for the towns of the Poznań voivodship

Sector	Observed mean	Mean of distribution which is			Ratio of randomness
		hexagonal	random	clustered	
	d_{tk}	E_h	$E_{rk/6}$	E_c	R_k
1	11.1	17.4	8.2	1.0	1.354
2	14.4	17.4	12.9	1.0	1.116
3	17.7	17.4	17.0	1.0	1.041
4	20.4	17.4	21.4	1.0	0.953
5	23.4	17.4	26.5	1.0	0.883
6	30.0	17.4	34.4	1.0	0.872
		D	D	D	R
		15.8	6.4	47.7	0.971

This ratio shows little local variation, which can be seen from the more or less equal values for all the general-economic regions of the Poznań voivodship (Table 5).

TABLE 5. Nearest neighbour statistics for the towns of the particular general-economic regions of the Poznań voivodship

Region	Number of towns	Density of towns	Observed mean sectoral distance	Expected mean sectoral distance in random distribution	Ratio of randomness
Northern	9	0.003169	21.1	21.9	0.9648
Central	46	0.003693	19.2	20.1	0.9587
Eastern	15	0.003531	21.3	20.7	1.0254
South-eastern	20	0.003699	19.9	20.4	0.9766
South-western	12	0.006030	15.9	15.9	1.0000

The present study attempts to test hypotheses concerning the spatial distribution of Polish towns by using statistics of distances between the towns in the nearest neighbour method. Our analysis has shown the distribution of towns to be a random one irrespective of the scale applied. The characteristics of these distributions was based upon a hypothetical mathematical process of the Poisson distribution type. Attempts at interpreting this random distribution in geographical terms prove rather difficult because we still do not know exactly which factors are responsible for a given type of distribution. That the distribution of Polish towns forms neither a hexagonal pattern nor exhibits any distinct clustering may perhaps be due to the fact that the broad geographic processes which determine the actual spatial distribution of the towns, do not merely result from the premises assumed in the theory of central places, but are

governed by much more complex multi-factor genetic-functional mechanisms. One significant factor tending the random distribution to develop into the clustered pattern is the process of industrialization.

Further progress in the assessment and interpretation of the deformations of the pattern must be based both on the study of different sizes of towns and functional types, and on modifying the Poisson distribution as the mathematical model.

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GEOGRAPHIA POLONICA 27, 1973

A SIMULATION MODEL OF URBAN GROWTH BASED ON THE MODEL OF THE OPPORTUNITY SELECTION PROCESS

Tadeusz Zipser

It is well known that despite the differences in the geographical and topographical environment and in cultural traditions, despite the varying technological possibilities and historical vicissitudes, the spatial patterns of modern towns exhibit obvious regularities. These regulatrities, together with the "spontaneous" development of most of today's large urban areas, that is not being subject to any comprehensive and consistent control, suggest the hypothesis that what we have is the result of a very large number of similar forces, which in their integrative effect can only produce limited number of solutions. In particular, this limitation of the possible solutions may be due to individual persons or institutions in an urban area not being able to satisfy their needs independently of each other. A complete satisfaction of these needs must therefore fulfill certain rigid and narrow criteria.

At present, also official comprehensive plans for some areas which are being urbanized are considerably altered as they are implemented.

Thus the main inference to be drawn from the regularities mentioned above, is that the principal ways of satisfying the needs in an urban area are fairly similar.

Hence we have a further hypothesis: the principal model describing the spatial aspect of the urbanization process must be relatively simple, in that the number of decisive independent variables should be rather small unless a greater differentiation of the results is expected. Thus all attempts at identifying such a model have to start from a model of satisfying spatial needs, and that it must use measurable parameters.

As these requirements are largely fulfilled by the gravity model, attempts to apply it to the spatial simulation of settlement structure have been made. But the model seems to have a defect; even a significant parameter like the power exponent, for the distances between the spatial elements of the pattern is an empirical coefficient and can be ambiguously interpreted; this makes any forecasting of its changes impossible. The gravity model takes into consideration the effect of distance, that with the growth of distance there may occur a certain diminution of the needs. Thus it is impossible to determine the effects of needs on distance, although this might be an important discovery.

The simulation model presented here, or more strictly, its essential mechanism, is based on the "intervening opportunities" model. Though this method of defining the exchange of movements between the elements of an urbanized area is well known, let us briefly recall its essential points in order to relate it to the discussion about the simulation model of settlement development.

The "intervening opportunities" model, developed in the USA by the CATS (*Chicago Area Transportation Study*) team was used to calculate the future exchange of movements between the various regions of the Chicago agglomeration, and was later successfully applied in similar calculations elsewhere. Tested by means of *ex post facto* forecasts, e.g. for the area of Washington D. C., it proved to be in good agreement with reality (C. E. Pyers). Its advantages, including the ability to interpret the parameters directly without reference to abstract coefficients plus the relatively simple calculation procedures, persauded many reserches to use it. Attempts were made to improve it (B. R. Ruiter), and even to use the model in a form virtually unchanged for the study of some problems in the choice of locations of private investments or residential buildings (*Niagara Frontiers Model* by G. T. Lathrop, J. R. Hamburg, also S. N. Swerdloff, J. R. Stowers, A. J. Miller and others).

When applied to transport and communications, the model is based on the following reasoning. Anyone who wants to satisfy some need, be it finding a job or a direct consumer need, considers the "opportunities" that are available to him at the given moment; these are points, from the nearest to the farthest where these needs can be satisfied.

Since it is impossible to analyse the motivations of each person participating in the communication process, both these extremely differentiated motivations and the equally differentiated opportunities are replaced in the model by the individual's random selection of each "opportunity". The probability of "success", i.e. the acceptance of the opportunity selected, is defined. The result is a sequence of Bernouilli samples, that is independent random selection with a constant probability of success, and the acts of selection are arranged in such a way that they correspond to the order of the "opportunities" from the nearest to the farthest.

Obviously, it is the probability of success about the mean distance of the trip, i.e., the mean number of failures preceding the first success that is decisive. Hence the distance of the trip is measured by the number of opportunities, and the decrease in the probability of success (that could be defined as the increase of selectivity or "fastidiousness' of the trips), causes a higher degree of penetration of the area surrounding the source of the movement.

It must be pointed out that for the sake of convenience in our calculations, we pass from the discrete space of Bernouilli samples to a continuous distribution in which the value of probability of success is substituted by the density of probability of acceptance, and that the selectiveness is characterized by this value. Hence the formula:

$$V_{i-j} = V_i[e^{-pa} - e^{-p(a+a_j)}] \tag{1}$$

defines the stream of the trips from region i to ring j surrounding region i at some distance; p stands for the density of acceptance probability; a_j is the number of opportunities in ring j; a is the number of opportunities closer than ring j; V_i is the number of trips starting from region i, e is the base of the natural logarithm.

By transforming this formula we can obtain further formulae defining the necessary area of "opportunities" i.e. the number of opportunities that at a given selectivity, which is denoted by value p, satisfies the desired percentage of needs. This is expressed by

$$a = \frac{\ln \frac{1}{R}}{p}, \tag{2}$$

where a denotes the number of opportunities that is necessary if no more than a fraction of needs R should remain unsatisfied, at a selectivity corresponding to p.

Similarly, when the area of opportunities is given, we can define at what selectivity it is still possible to satisfy a desired percentage of needs in that area. For this purpose we must use the formula:

$$p = \frac{\ln \frac{1}{R}}{\bar{a}}, \tag{3}$$

in which the logarithm of the reciprocal of the "residue" — the fraction of unsatisfied needs — is divided by the number of opportunities found in the area.

Owing to the ease of obtaining the values of the parameters of the probability of success, we already have a good knowledge of the numerical values characterizing the current selectivity of diverse trip-generating categories of needs in the urbanized areas. This is true provided we have at our disposal adequate measurements of the number of trips, and know the distribution of the potential destinations of those trips. For instance, we know the selectivity of commuting to work for each of the 54 regions into which the city of Wrocław has been divided for this type of computation, and for several other Polish cities also, for certain categories of service-oriented trips. All these values exhibit a similar hierarchy in the order of needs by the value of the parameter; they even attain an approximate, if not identical order of magnitude, to similar data obtained in western countries.

What is important is to realize the nature of the key parameter — the selectivity characterized by the value p. This parameter is codetermined by at least three principal factors. A fundamental factor is the selectivity which resulting from the fact that the need itself is differentiated, e.g., according to professional specialization, fastidiousness, definite preferences and likings for purchasing, cultural and other requirements, etc. Another factor is the level of information which decides whether each "opportunity" is in fact considered; some "opportunities" may be missed due to a lack of information about them. The third factor is the degree of random mixing of destinations and sources in the area. It is easy to show that a relevant ordering, in the sense of direct proximity of the sources and destinations would considerably diminish the "selectivity" of the model.

But it is well known that complete ordering is impossible due to the diversity of the interrelationship among the individual sources and destinations of the trips, in that the trips within an urbanized area cannot be discriminated in order to obtain independent source-destination pairs. On the one hand, there are many factors conditioning close links between, or even conglomerations of, the destinations. For example there are economic reasons for grouping workplaces in big production plants, or for concentrating diverse service functions in warehouses, cultural centres, etc. The factors which concentrate urban-generating functions in settlement areas are difficult and are only indirectly to describe and analyse, reflected in the measure of selectivity. On the other hand, the source of the trip is often the place of residence of an individual whose needs are not limited to one type of trip, say to commuting to work, and hence a location that may be optimal with respect to one need may not be so for another category of needs. A further factor in concentration of sources of the trips is that there may be several members in one family. Although all these

factors are vague and difficult to comprehend, their importance in the selective process is readily observed. Since this selectivity is a measurable parameter of the model, it may be treated as a measure of the total effect of all the above-mentioned factors.

These features of the parameter seem to suggest a further advantage of this model over the gravity model. All possible changes in the value of the parameter p can be interpreted; consequently, its future changes can be forecasted, and its changes in the past are assumed to have taken place in this or that way. Moreover, it is possible to attribute hypothetical levels of selectivity to different types of settlements depending on the occupational structure of their population, occupational and cultural differentiation, the partitioning or aggregation of working establishments, and even on the family size or the population number.

In the gravitation model the key parameter of the model is the exponent of the power of distance and this merely reflects the frictional effect of distance. It would be difficult to explain both why it should have been different in the particular periods of the development of an area in the past if there have been no great changes in communications and transport, and why the parameter should be more pronounced in some subarea than in others.

Independently of the positive results of tests performed on the model, and its advantages discussed so far, the "intervening opportunities" model has demonstrated its usefulness, and has shown a promising accordance with reality by a different method.

The only considerable flaw in the model as a method for determining the interregional balance of trips is the persistent "surpluses" of trips into some regions, and the "deficits" of trips into some other parts of the area. These distortions of the balance, which are neutralized in predictions of trip exchange by the usual equalizing techniques (although this is incompatible with the fundamental assumptions of the model), greatly depend on the traffic advantages that the given place offers for transport. Their distribution coincides with the areas that in reality have either the most pewerful processes of concentration or growth. The principle of equalizing the balance by successive shifts of the potential destinations which satisfied the observed surplus trends, rather than by a coarse equalizing of sums, has been used to develop an original simulation model. This has already been successfully employed in reconstructing the results of the processes of concentration in settlements, by building up "synthetic" pictures of towns that have proved to be in good agreement with reality. These features of the simulation model seem to augur well for its future use as a tool for making predictions in the field of settlement developments.

Thus the simulation model based on the "intervening opportunities" idea is founded upon the assumption that the selectivity of needs, and the definite accessibility pattern of a given area, make it necessary to distribute the sources and destinations of the trips in such a way that the system should be kept in equilibrium as much as possible. This equilibrium is to be understood as denoting a situation in which the number of needs to be satisfied in a given zones, as imposed by the area's selectivity, will agree with the number of opportunities that are to be found there.

The above requirement usually boils down to minimizing the duration or the distance of the trip, while keeping the selectivity unchanged. This tacitly implies a certain egalitarianism of the individual users of the system, for any other solution would introduce distortions into the assumed selectivity of some of them.

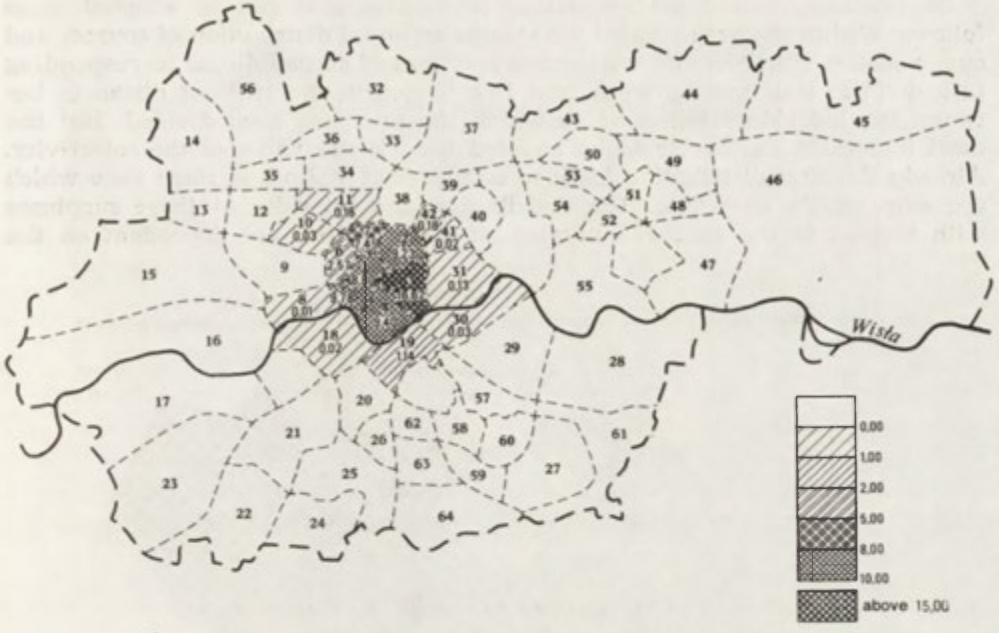

Fig. 1. Cracow city. The results of the simulation (general shifting). A regular distribution of the sources and destinations over all 64 districts was the original situation. The Figure shows the relation of the "quantities" obtained in the simulation and the initial "quantities".

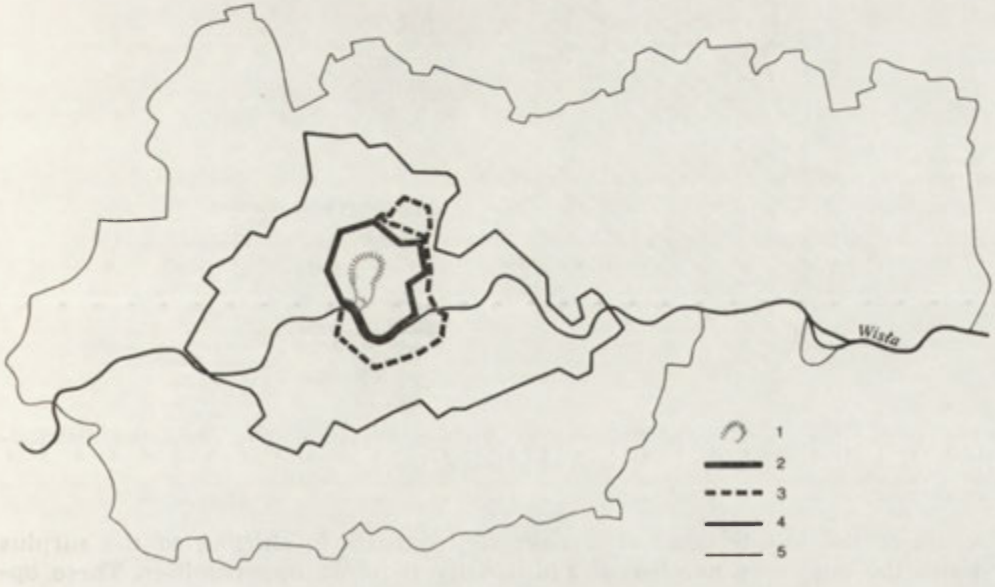

Fig. 2. Cracow city. The city's boundaries in the 19th century
1 — green belt, 2 — city boundary from 1867–1909, 3 — Austrian fortifications 4 — city boundary since 1915, 5 — contemporary boundaries

In practice, one of the simulation procedures that can be adopted is as follows. Within the area studied we assume an equal distribution of sources and opportunities. Furthermore we assume a system of accessibilities corresponding to a definite transport network, and is reflected in the table of distances between the individual regions into which the area has been divided. But the most important parameter to be adopted here is the value of the selectivity. Already the first distribution leads to surpluses of visitors to some zone which are more easily accessible. The distribution and intensity of those surpluses with respect to the averaged number of opportunities are dependent on the

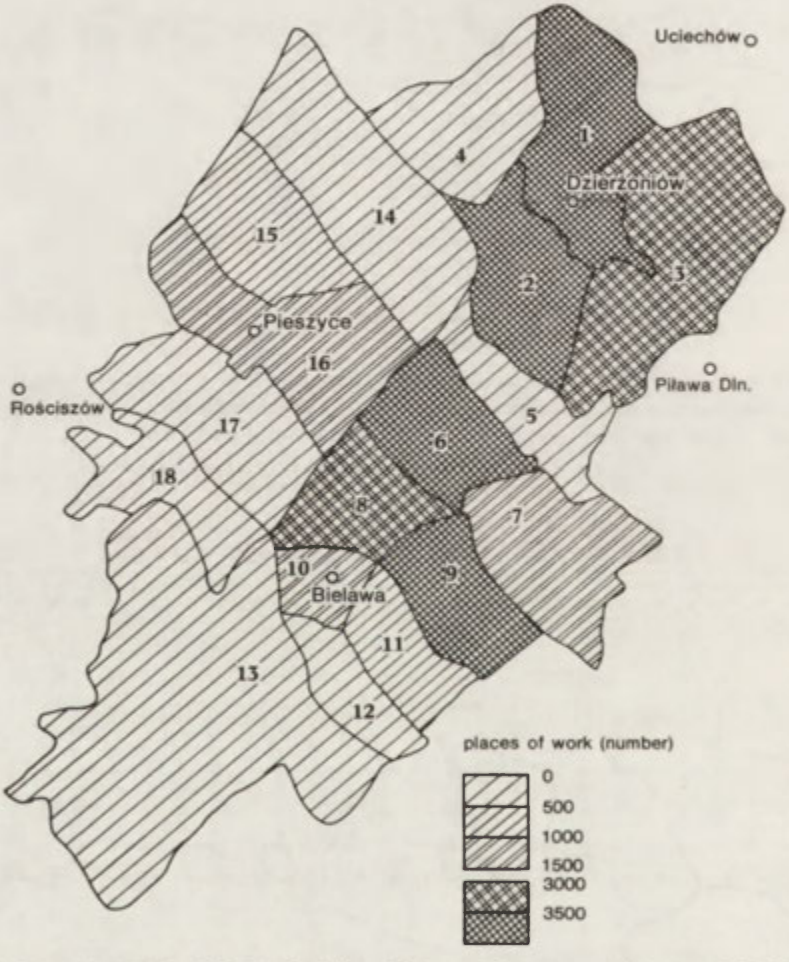

Fig. 3. The town system of Dzierżoniów–Bielawa–Pieszyce. The simulated distribution of places of work

value of the selectiveness. The next step consists in shifting to the surplus zones the necessary number of additionally required opportunities. These opportunities are taken from those areas with a deficit of visitors.

The distribution is repeated, this time taking into account the new spatial pattern of opportunities; in doing so we again obtain surpluses which can in-

dicate new shifts. In this manner, by successive approximations, we eventually arrive at a state of equilibrium with no surpluses but which can be occasionally marked by considerable changes in the distribution of destinations compared with the original state of affairs.

Another variant is to shift both the opportunities and the sources to ensure an equal number of the two in each district. This procedure best reveals the most striking examples of concentration in areas which have more than one focus of concentration. A picture of nineteenth-century Cracow (Figs. 1 and 2)

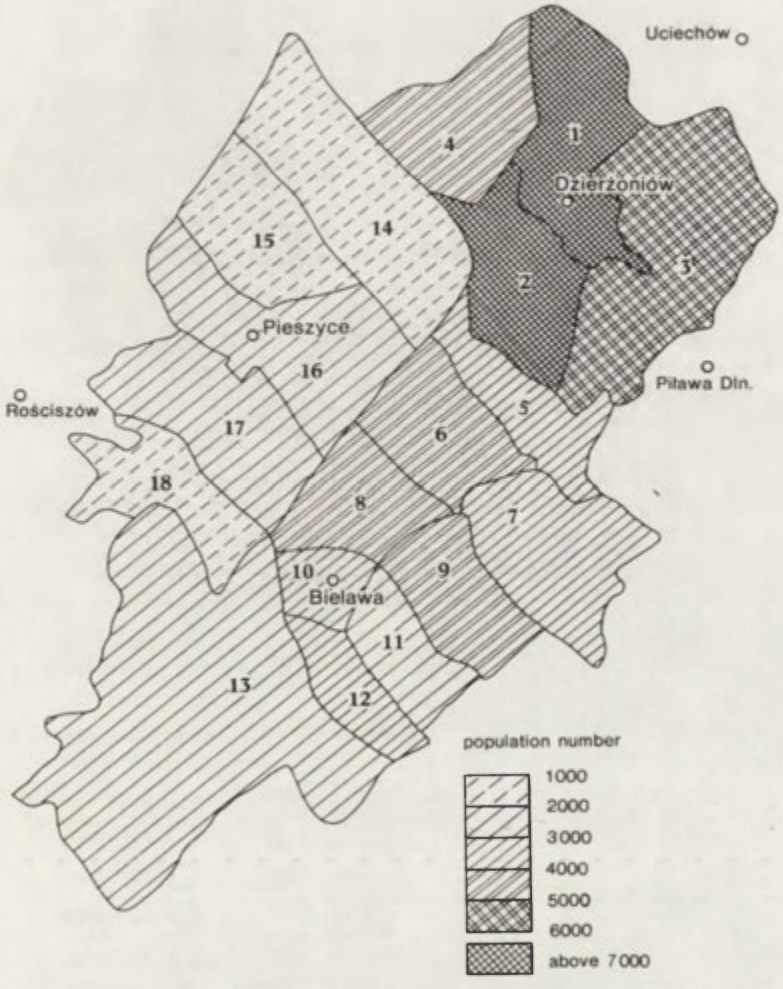

Fig. 4. The town system of Dzierżoniów-Bielawa-Pieszyce. Actual distribution of population

was obtained by this method, as well as distributions of the settlements of the regions of Świdnica, Konin and the town-complex of Dzierżoniów–Bielawa–Pieszyce (Figs. 3, 4 and 5), all of which were found to be in a good agreement with reality. Similar results have been obtained by simulating the concentration

processes in Wrocław, Szczecin, Poznań as well as for the whole administrative region of Cracow (Figs. 6 and 7). But shifts in the destinations assuming only the immovability of the sources, distributed according to their actual or their model pattern, enable the researcher to find the optimal location of the opportunities, of the services type for example. This may be used in deciding the distribution and programme of the service centres of different levels. Such experiments were made with the examples of Gliwice, Poznań and Wrocław.

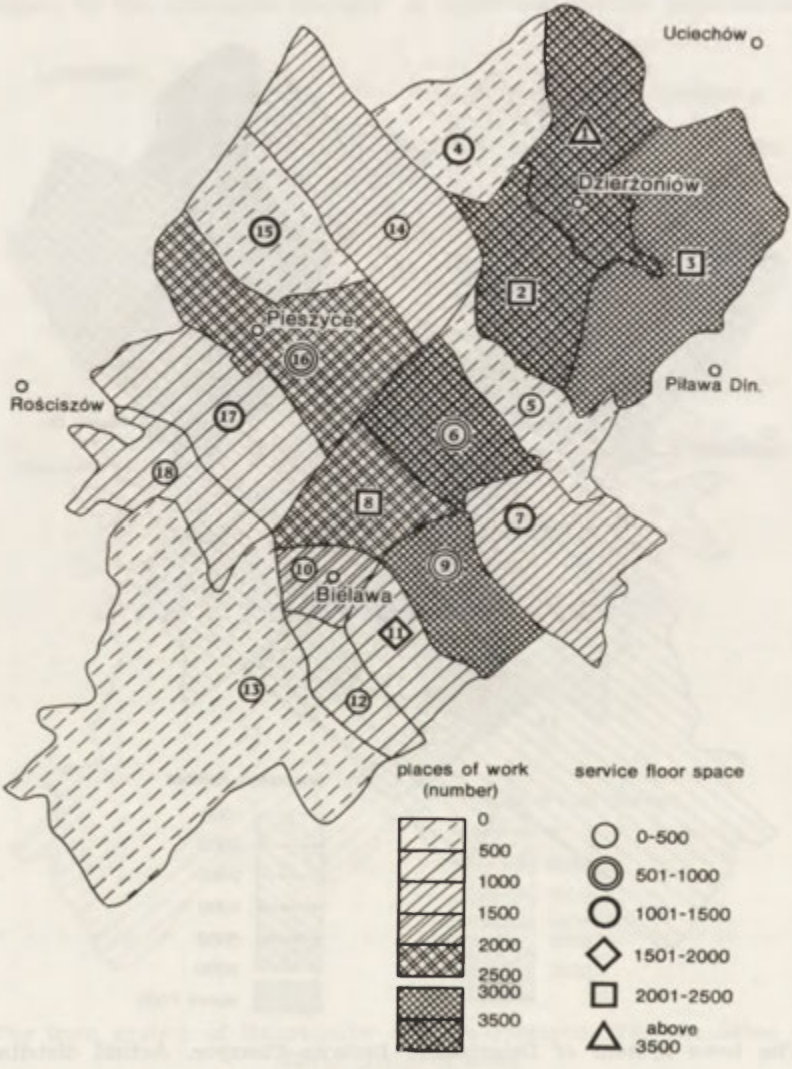

Fig. 5. The town system of Dzierżoniów–Bielawa–Pieszyce. Actual distribution of places of work and services. Service floor space in m²

Special attention is to be paid to simulations made on regular patterns, differing according to the system of transport and communications, i.e., the system of accessibilities (Figs. 8 and 9). In such cases it is possible to see the

mechanism of the emergence of certain phenomena in the model, phenomena that are known in analyses of the more recent urbanization processes. It seems that the results obtained may illustrate the operation of what is called the Clark rule, i.e., the depopulation of the agglomeration centres and the "wave-like" expansion of the areas that show the most dynamic processes of development (P. Korcelli 1969). Many authors have also studied the recent problem of the disagreement between the modern form of shopping and the use of other services, with Christaller's theory of central places (J. E. Brush, J. R. Tarrant, M. Palomaki and others).

On the other hand, in some areas of Europe, Christaller's theory proved adequate in the past and even now still applies to some areas. In the simulation model discussed here it is merely a question of the selectivity, which up to a certain limit favours (with an adequate stratification of the needs of differ-

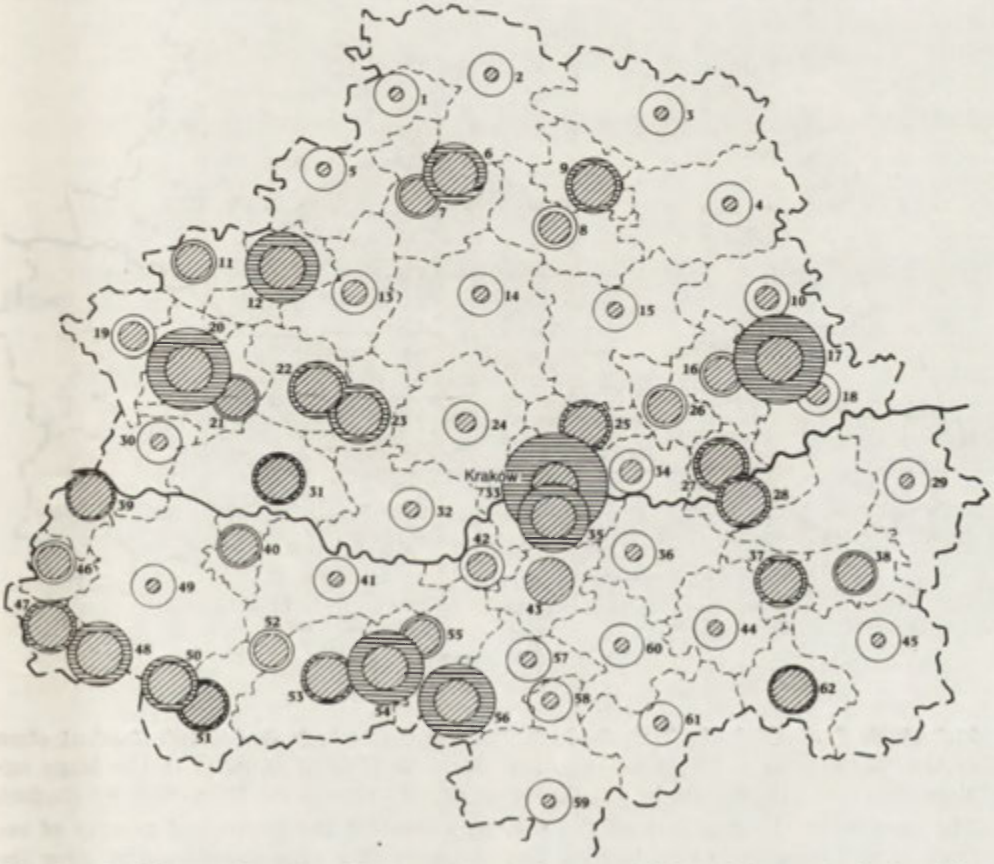

Fig. 6. The Cracow Region. The results of the simulation at low selectivity. The original situation: no differentiation in the number of sources and destinations per district. Concentrations in places corresponding in most cases to the positions of towns were found; the highest concentration was Cracow city.
Horizontal lines — increases obtained through simultation. Diagonal lines — the part of the initial "quantities" retained in the simulation
Circles — the part of the initial "quantities" lost in the simulation
The figures represent the numbering of the regions at the time of calculation

ent selectivity) an agreement between the actual picture and the central places theory. Above that limit, together with the diminution of the value of p (i.e. the growth of selectivity) the primary structure is destroyed and gradually replaced by a new "agglomeration" or "conurbation" system. The usefulness of the intervening opportunities model for the description of consumers' behaviour in the peripheral zones of metropolitan areas has been pointed out by J. E. Brush.

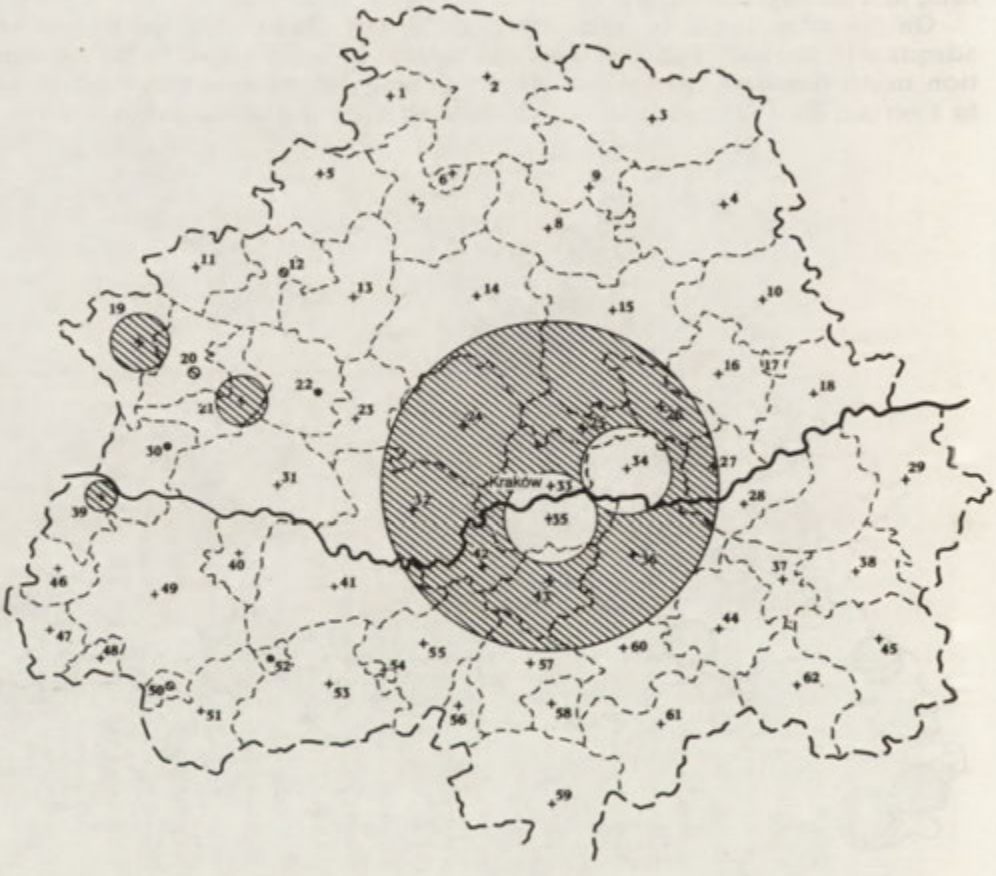

Fig. 7. The Cracow Region. The results of simulation at high selectivity. Concentration of the whole mass (which originally had been distributed equally) in the large agglomeration of Cracow and in a few smaller centres (Jaworzno, Chrzanów, Oświęcim). The crosses by the numbers of the regions represent the centres of gravity of regions, which have decreased to zero. The circles with a criss-cross pattern show the values after simulation. (The circles in regions 34 and 35 have been left white for clarity).

The next important step in the improvement of the model, which at present is a very rough and a preliminary one, is to introduce the possibility of including arbitrary and "external" decisions. This should also include the distribution of raw materials, advantageous topographic, climatic and other condi-

tions, plus the barriers of growth represented by various local limitations (e.g. unfavourable physiographic conditions, the inaccessibility of the area for investments, limitations to the population density, etc.). These barriers may as-

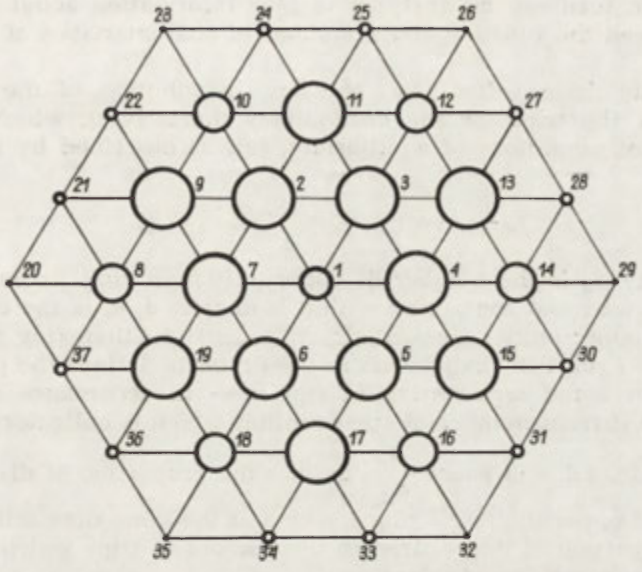

Fig. 8. The results of the simulation of the distribution of concentrations of service targets in two different regular communication lines.
The variant of the triangular network is a ring-polycentric effect

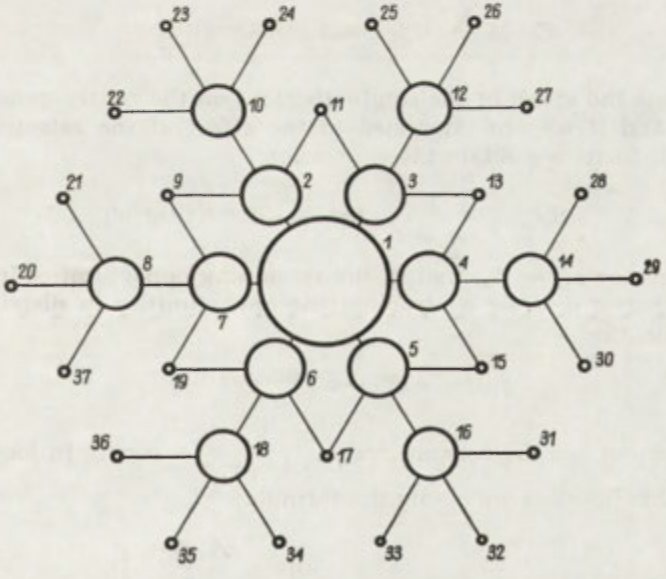

Fig. 9. The results of the simulation of the distribution of concentrations of service opportunities in two different regular communication lines.
The variant of the radial network in a monocentric effect

sume the character of upper limits, assessed differently for different forms of economic activity.

Finally, it must be added that the driving force of the model — namely the trend toward surpluses — can be expressed in the form of a function, and that this function in turn can be analysed to give information about the principal relations between the function and a number of characteristics of the elements of the model.

Thus the simulation effect, i.e., the new distribution of the sources and destinations of the trips (or the destinations themselves), which fulfills the above mentioned conditions of equilibrium, can be described by the following equation

$$V_i[e^{-pa_i} - e^{-p(a_i+a_{jt})}]\frac{A'_d}{a_{jt}} = A'_d + \alpha \tag{4}$$

for all d, where a_{jt} is the number of opportunities in ring j constructed with respect to district i and containing within it district d; a_i is the corresponding number of all opportunities situated closer to district i than ring j, constructed with respect to i (thus the expression in the brackets defines the probability of trips started in i and terminating in ring j — in accordance with Eq. (1), A'_d denotes the current number of opportunities which is obligatory in the final iteration in district d, and hence $\frac{A'_d}{a_{jt}}$ defines the proportion of district d in the total number of opportunities of ring j, which at the same time settles the question of the proportion of that district in the number of trips which terminate in the ring; α is here an assumed tolerance.

It is also possible to give a formula for the "centre-generating force", which makes it necessary to move opportunities from some districts to others. What we have here is the ratio of trip terminations in district d to the number of opportunities in that district. This is expressed by the formula

$$O_d = \sum_i V_i[e^{-pa_i} - e^{-p(a_i+a_{jt})}]\frac{1}{a_{jt}} \tag{5}$$

If we can isolate the effect of the single district i on the centre-generating force in district d, and if we are interested in the effect of the selectivity, i.e. the p value, on this force, we obtain the expression

$$O_{dt} = \frac{V_i}{A_d + r_{ij}}[e^{-pa_i} - e^{-p(a_i+A_d+r_{ij})}] \tag{6}$$

where r_{jt} stands for $a_{jt} - A_d$, that is, the remaining opportunities in ring j constructed for district d, after subtracting the opportunities in district d. Let us consider the function

$$f(p) = e^{-pa_i} - e^{-p(a_i+A_d+r_{ij})} \tag{7}$$

(where the fraction has the constant value $\frac{V_i}{A_d + r_{ij}} = \text{const}$). In looking for the maximum of this function we obtain the formula

$$O_d \text{ max when } p = \frac{\ln\left(1 + \frac{A_d + r_{ij}}{a_i}\right)}{A_d + r_{jt}} \tag{8}$$

This formula is meaningful when a_i is greater than zero. It must be noted that when the simulation procedure consists in shifting not only the sources but also the destinations, then apart from the equilibrium equation, we must also consider the condition $V'_d = A'_d$. This defines the number of trips starting in district d from the next iteration as equal to the number of destinations in that district.

What has so far been found in applying the model in practice is that one should proceed by primarily shifting both the sources and destination employing the selectivity of commuting to work, and that after attaining equilibrium the sources should be stabilized by merely shifting some service opportunities (because of the specific selectivity for a given type of need).

The method of shifting the destinations and sources of the trips in an unchanging system of accessibilities as discussed here is not the only possible algorithm. The following procedures should be particularly mentioned.

(1) The transformation of the transport network, i.e., the system of accessibilities, whether at a constant or variable level of selectivity.

(2) Changes in the intensity of developing the particular regions, keeping constant proportions in this development, and un unchanging system of accessibilities at different values for the selectivity.

(3) Differentiating the levels of selectivity at a constant distribution of economic development and a constant system of accessibilities.

Combinations of all these procedures are also possible.

It may be generally said that at present it is already possible to select an optimal settlement structure in the sense of transport and communications networks and the distribution of economic units (conceived of as a set of sources and destinations of the trips), for different values of the selectivity. The next step would include the model in a more comprehensive simulation game enabling the individual "players" to modify the parameters that are dependent on them. One example of such a game could be a model of changes in an urban area where the decisions about settling, about changing the extent of penetration of the environment by individuals (or groups of individuals), decisions about this or that saturation with the opportunities of the area — all these are made through a confrontation of the selectivity and extent with the distribution and differentiation of the possibilities of satisfying the existing needs.

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URBAN GROWTH: SOME MODELS AND GENERALIZATIONS

Piotr Korcelli

TYPES OF MODELS AND THEIR CHARACTERISTICS

In geography and urban planning, as in other disciplines, the term "model" has two different meanings. The first meaning follows the definitions formulated by some methodologists in science, such as Braithwaite, who treat a model as an expression of a theory or a means of representing one (D. Harvey 1969, p. 145). According to the second interpretation a model may be defined as a sequence of rules, or a procedure which is followed, in order to solve a particular problem. In building a model of the first type one tries to achieve maximum generality, while the prime requirement for a model of the second type, given its internal coherence, is its suitability for empirical testing. The following discussion is mainly about empirical models, and therefore some space should be devoted to outlining their basic classification within the context of the study of urban growth.

A good starting point is the three-fold division of the models of urban growth and internal structure put forward by I. Lowry (1965). On the basis of their functions Lowry identified three groups of urban models: descriptive models, predictive models, and planning models. The objective of the first type of urban model is to present, in a simplified form such as a mathematical formula, the intricate phenomena and processes that occur on an urban or metropolitan scale. The measures of the accomplishment of a descriptive model are: one — the ratio of input data required by the model to output data generated by the model; two — the accuracy and cost of the generated output compared to the direct observation of the relevant variables; three — the spatial and temporal range of the applicability of the model. In the case of a predictive model, according to Lowry, it is not sufficient to note a covariance between individual variables; in order to predict their values at some future time the model must specify a casual sequence. It is also necessary to be able to assess the value of endogenous variables for the time periods covered by the prediction. This requirement can be partly relaxed with conditional predictions. A planning model incorporates the mothod of conditional prediction, but it goes further by evaluating the output from the viewpoint of the planning goals. The typical structure of a planning model consists of four elements: specifying alternative programmes, predicting the consequences of choosing each alternative, evaluating these consequences in the light of goal priorities, and selecting the alternative which yields the highest score on the goal-achievement scale (I. Lowry 1965, p. 159).

The interrelationships between predictive and planning models are explicitly given by Lowry. Planning models are described in terms general enough

to apply to all existing systems of planning. Basic differences between various planning systems are relevant to the definition of objectives and to the question of plan implementation. The distinctness of socialist planning in these areas defines its own specific methodology.[1] According to the prevailing interpretation a planning model usually encompasses some planned variables, and others which are subject to prediction. The predicted variables are those whose future values are not dependent upon the planner's decision.

The characteristics common to predictive and planning models are by no means limited to the estimation of future magnitudes and directions of change. In his models of commuting to work and the location of places of living and of employment, A. Wilson (1967) postulated that the planning versus prediction problem may be interpreted in terms of the type of constraints introduced into the model. In this case population and employment within individual subareas of a city may either be treated as endogenous or exogenous variables, determined by the planner. In a planning model, individual postulates of the arriving at particular goals are being introduced in the form of additional exogenous variables. The predictive and postulative elements co-exist in a planning model, their proportions depending, among others, on the kind of problem being studied and the decision-making processes involved.

These general statements about the similarities and differences in the character and structure of predictive and planning models bring us to their methodological foundations.

In the study quoted earlier on social premises in shaping the city of the future (*Sotsyalnye predposylki formirovanya goroda budushchego,* 1967) two principal philosophies of prediction were discussed: those based on extrapolation and those on intuition. This roughly corresponds to the division of the prediction methods into quantitative and non-quantitative (Z. Chojnicki 1970). According to the methodology of science the only sound bases for building predictions are scientific laws. As in other intricate social phenomena, the growth of urban areas has not yet been described by a system of laws. Furthermore, it is rather doubtful whether such laws will be formulated in the foreseeable future. Therefore, the role of extrapolation (broadly defined, and including simulation and analogy) in predicting urban growth is not likely to diminish, despite its various shortcomings.

In planning models the extrapolation techniques are used to estimate the endogenous variables. While in predictive models the development of the method of prediction is frequently a principal goal, a planning model extensively adapts tested techniques. It is not infrequent, however, for new extrapolation models to develop within the framework of a planning model. Trip distribution models may serve as examples.

In a scheme developed recently by W. Wilson (1968), the so-called "relevance tree" depicting links and interrelationships within a planning model, the term "prediction" was substituted by a broader notion of "understanding". The latter

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[1] Spatial and temporal differentiation in goal formulation in the planning of urban development should be analysed separately. In the discussion which has been carried on in various countries in recent decades, two stipulations have achieved nearly universal acceptance. One of these is a postulate of the flexibility of the planned urban structure, which should withstand changing demand and technological factors. The other concerns the precedence of social goals over purely economic aims. A recent volume on the social premises in shaping the city of the future abundantly covers these problems (*Sotsyalnye predposylki* 1967). A detailed analysis of Polish urban planning experience is given by J. Kolipinski (1970).

forms a lower segment of the relevance tree and is composed of two elements: the development of models for individual intra-urban systems (residential, workplace, economic activity, infrastructure, transport, social services, etc.), and the selection of techniques, taking into account the principles of model design, availability of information and computing facilities. The middle part of Wilson's model is connected with the design; here an urban planner must decide upon the plan structure, the time horizon, the treatment of uncertainty, and choose proper design techniques. The upper segment relates to policy, and is split into the levels of evaluation, goals, and action leading to plan implementation.

In the light of these formulations the traditional division of studies of urban growth and internal structure into "academic" and "applied" is somewhat artificial; the same is claimed by Wilson. The stage of "understanding" or prediction within the plan development requires considerable theoretical sophistication; operational models, on the other hand, developed within some planning projects, often contribute to the "pure" theory. The value of a planning model is both a function of the proper identification of goals and of the correct estimation of the future values of those variables which cannot be directly controlled. The building of urban planning models is therefore closely related to the progress in urban theory and to the development of predictive models based upon the theory.

EXAMPLES OF MODELS STRUCTURE

The analysis of several selected models of urban growth, presented below, should illustrate the sequence from theoretical constructs to planning models and to show the potential of generalizations contained in descriptive geographical models of a city, when applied to predictive models, for urban and metropolitan planning. The studies discussed below are mostly concerned with the residential sector; their theoretical framework is related to three distinct streams of thought: population density gradient, spatial diffusion, and spatial interaction.

URBAN POPULATION DENSITY MODELS

The one most widely tested and universally accepted generalization in the spatial structure of urban areas is the concept of population density as a negative exponential function of the distance from the centre of the city (C. Clark 1951). Clark's empirical formula was further developed and generalized by such authors as Gurevich and Saushkin (1966), Casetti (1967) and Papageorgiou (1971). In contrast to other regularities, such as those depicted in ecological models, the negative exponential rule applies to cities of different socio-economic and cultural systems. The analyses of density profiles have been carried out for at least several hundred cities of various size categories. No city has so far been found for which the rule has not held. However, because of the difficulty associated with building population potential models based upon the negative exponential function (see M. F. Dacey 1971), the applicability of the latter to the study of a wide range of economic and social phenomena is rather limited. The notion of the regularity and stability in density profiles can nevertheless be applied within a dynamic context. An example of such an application is a model which predicts the territorial expansion of the San Fran-

cisco urban area on the basis of the evolution of the profiles of population growth and density (*Future development*, 1959).

The method used by the authors of the San Francisco study was to classify the profiles of density increase, which they then used for extrapolating future densities for areal units peripherally situated in the urbanized area. The projection takes into consideration the geographical and economic conditons, and territorial analogies in terms of these conditions, as well as changes in the rate of growth and directions of expansion of the whole urban complex. The empirical analysis is composed of the following steps:

(a) Calculating the density estimate for individual areal units (townships) for the base year. This was done by simple extrapolation; the mean annual rate of density change for the past years was simply extended.

(b) Calculation of the rates of density change (measured in terms of the number of new inhabitants per unit of territory) for all the townships within the study area and for all the past decades (1900–1910 to 1940–1950); arraying these densities in order of decreasing size; dividing the array into five class categories (A, B, C, D, E), and determining the mean density of each category.

(c) On the basis of these and similar data for 61 other large urban areas, the length of periods characterized by given categories of rates of density change were calculated. The most probable duration of each growth rate was determined and a "normal sequence of growth" established. The typical sequence was found to be DDCCBBB, which means that three decades of rapid growth (B) are usually preceded by two decades of gradual growth (C), which in turn are preceded by two decades of slow growth (D). Very rapid growth (A) was assumed for some peripheral areas of the central cities, and sites of major industrial expansion where three or more decades of the B class of growth had already taken place.

(d) Fitting the "normal sequence of growth" principle into the profiles of rates of density change for each township, and the development of density projections for the period 1970–2020.

(e) Development of a density-change table by using the procedure specified in the previous steps, but with several modifications. These, among others, include: the reduction by one category than would have been appropriate for the "normal sequence of growth" of all the rates for the years 1960–1970 and 1990–2000 (periods of anticipated slow economic growth), and adjusting the temporal and spatial distributions of high growth rates for local trends, variations in the geographical environment and development plans.

(f) Testing the reliability of the results obtained against the actual structure of population density within other large urbanized areas, and against projections developed by the Bureau of Census for both the region in question and its major components.

The study outlined above is an attempt to identify trends in population density changes within an urban region; it is therefore an extension of the extrapolation methods which were used earlier. There are, however, some inconsistencies in the method described. One of these is measuring the density change in terms of absolute population increases. According to this technique, the increase in density from 10,000 to 11,000 persons per square mile is classified as "very rapid" (A), while the increase from 100 to 250 persons is regarded as "gradual" (C). Another shortcoming is the failure to take into account possible decreases in the population density within the central parts of the urbanized area. In this case the results of 1960 and 1970 population censuses have illustrated the fallacy of extending past trends. To sum up, the analysis of population density change proves useful for long-term urban and regional planning, but its validity

for building short and intermediate-term models (with closer time horizons) is rather limited.

WAVE-LIKE MODELS

The wave-like concept of urban growth stems from several earlier theoretical approaches; its strongest links are with the theory of the diffusion of social phenomena, although it also adopts some ecological postulates as well as density gradient generalizations. The development of the concept and its main assumptions are discussed elsewhere (P. Korcelli 1972); the following remarks relate to its applicability to prediction and planning. The origin of the wave-like concept was a registration of certain empirical regularities; their generalization has produced an analogue model. It is worthwhile noting that similar results can also be obtained by juxtaposing certain formulae which describe an urban system and a system of waves. Such a comparison, involving the Clark formula and the formula for a system of trochoidal waves, was recently offered by Gokhman, Gurevich and Saushkin (1968).

An attempt to build an operational wave-like formula which would simulate territorial expansion (measured in terms of population redistribution) was proposed by Blumenfeld (1959). The formula used by Blumenfeld may be represented as:

$$M_{ti} = 0{,}0085\, I_t D_i$$

where:

M_{ti} = distance which the concentric zone of a density i covers during time period t moving outward from the centre of the metropolitan area,

I_t – percentage growth of the total population of an area during time period t,

D_i = initial distance of the zone of a density i from the centre of the metropolitan area.

According to the formula the movement of lower density zones situated further out from the centre of a metropolitan area, is more rapid than that of higher density zones. The rule applies to zones of suburban growth and cannot be used to estimate the evolution of central densities. It was established from empirical data for two metropolitan areas (Philadelphia and Toronto) that its predicting power might be substantially smaller in the case of a larger sample of urban areas and longer time spans. Even in the case of Toronto, the predicted distribution for 1980 was assessed by the author as a rather unlikely.

If we stipulate, however, that a zone of a given density (or a given rate of density change) represents a crest or another fragment of a "wave" of urban growth, then the formula cited may be regarded as a first approximation of an empirical wave-like model. To build such a model it would be necessary to reformulate the traditional scales of urban growth, such as population density, rate of population increase, distance from the city centre, into a system of trigonometric measures, such as amplitude, period, phase, etc., which are used in the description of wave-like phenomena (see: Gurevich 1967). A translation of this type would allow one to apply, in analysing the territorial growth of urban areas, the classical wave formulae, such as the equation that gives the profile of a simple sinusoidal wave:

$$a_i = A_o \sin 2\pi ft$$

where: a_i = vertical displacement of point a

A_o = wave amplitude
f – frequency
t – time

The next stage would be to develop equations accounting for peculiarities in the "waves" of urban growth.

Testing hypotheses about cyclical and wave-like properties of urban growth is closely related to the adoption of time series and spatial series analyses to the study of the diffusion of cultural phenomena (see: Korcelli and Kostrubiec, 1973). The application of these methods in geographical research has recently increased, and ranges from analysing the distribution of urban places to investigating the sequence of meteorological phenomena (L. King 1969). The method of studying periodical occurrences allows one to isolate the overlapping cyclical components of a given process. The harmonic analysis, or Fourier series analysis, allows one to determine the parameters of the individual periodical components, while the spectral analysis defines the contribution of the individual frequency classes in the whole spectrum. A broader utilization of the time series analysis in the study of urban development partly depends on the availability of long series of temporal and spatial statistical data. To carry out a spectral analysis, for example, the coordinates of at least one hundred points in time or space are required.

Generally speaking, wave-like models of urban growth have not yet reached an operational stage, and their utility for building predictive and, ultimately, planning models of urban development, is at present difficult to estimate. It seems, however, that as with urban density models, which were discussed in the previous section of this paper, wave-like models, when developed, could be used to predict the general parameters of urban expansion but give way to other kinds of models for detailed (both in the temporal and spatial sense) predictions.

FUNCTIONAL MODELS

In contrast to the studies discussed so far, whose search for regularities in population redistribution in urban agglomerations leads to the formulation of "empirical laws" or analogue models, the functional concepts assume, as a starting point, the existence of certain, mostly economic, interdependencies in an urban region. These interdependencies concern first of all the territorial distributions of living places and places of employment, as well as the relations of these patterns to shopping, recreational patterns, etc. In comparison with other approaches functional concepts can be more easily operationalized, and are much more applicable to the construction of urban planning models. These characteristics fully pertain to the models discussed below. The first model was constructed by a Soviet city planner, M. O. Chauke (1960), the other was developed in the Centre for Environmental Studies (London).

M. O. Chauke in a paper on the regularities in the intra-urban and suburban population structure criticized the planning concept of balancing population and employment on a city-district scale. This concept, according to Chauke, failed to take into account the role of the central zone as well as some other aspects of intra-urban functional specialization. Chauke proposed that the number of inhabitants within a given urban subarea should be a negative function of its distance from the points of heavy day-time population concentration (he calls these points centres of high attendance), and a positive function of their masses, measured by the average number of visitors during a day. The formula reads:

$$P_k = \frac{pE_k}{\sum_{k=1}^{n} pE}$$

where: E_k = number of persons visiting centre k
p = probability index, which determines the population distribution in relation to the distance from a centre of population concentration.

Chauke devoted much of his article to the methods of identifying the masses of individual centres of population concentration and the spatial probability patterns of population distribution in relation to these centres. Chauke considered the city centre, large industrial enterprises, major institutions, mass transportation junctions (for example railway stations) as centres of concentration; he disregarded those centres of employment which are distributed more or less uniformly throughout an urban area. The formula may be regarded as a kind of potential model, as it relates the magnitude of interaction to the parameters of mass and distance. The latter element is built into model in the form of constant probability rations (1; 0.5; 0.3; 0.2; 0.1; 0.04) for subsequent time-distance zones. The equation may be used to calculate, for individual territorial units within an urban area, the accessibility to centres of employment; hence its relevance to urban planning is evident. The model may illustrate the existence of direct links between the identification of regularities within an urban system and the formulation of planning goals concerning urban development.

The study by M. Cordey Hayes *et al.* (1970) also tries to build an operational and a planning-oriented model of urban growth. According to their assumptions, a model of this kind should be relatively simply but flexibly constructed; it should have a hierarchical structure which allows one to use the model at various levels of data aggregation and within alternative decision-making frameworks; finally, it should have a form suitable for electronically processing its input.

As a starting point they use Lowry's formula:

$$P_i = g \sum_j E_j f(c_{ij})$$

where: P_i = the residential population of zone i
E_j = number of jobs in zone j
g = the normalizing constant, which ensures that P_i sums to a given aggregate population
c_{ij} = distance, or cost of overcoming the distance, between zones i and j

The improvements introduced by the authors include:

(a) the introduction of a variable w_i, which denotes the "intrinsic attractive power" of a zone. This factor represents those attributes of an area which make it attractive for residential development but which are unrelated to its proximity to workplaces;

(b) the introduction of the concept of competition among residential zones;

(c) the inclusion of constraints on the population capacities of some zones;

(d) the consideration of disaggregation of such locational characteristics as wage levels and house types.

Assuming that the population in zone i which finds employment in zone j is directly proportional to: the number of jobs in zone j, a decreasing function of the cost of travel between i and j, and to an intrinsic attractive power of zone

i for residential development, then the residential allocation model is written as:

$$P_{ij} = gT_{ij} = \frac{gE_jW_if(c_{ij})}{\sum W_if(c_{ij})}$$

where T_{ij} is a measure of interaction between zones i and j. This equation allows us to predict the distribution and redistribution of population within individual zones, while making this prediction conditional upon the distribution of exogenous employment and on a friction of distance function.

The theoretical background of the functional models of urban growth is usually a combination of the urban economic base theory and the concepts of socio-economic interaction in space. The techniques used in the model formulation include such broadly tested and well developed methods as gravity models and multiplier models. Normally, the structure of functional models is quite flexible, which is related to its circularity, and allows us to make adjustments in the level of aggregation. Features such as the possibility of determining the effects of hypothetical investment decisions on the population distribution, or the applicability to testing alternative development programmes, place the functional models of urban growth in the category of predictive models most relevant for building planning (sub)models.

CONCLUSIONS

The paper has touched on three interrelated questions, which have been extensively discussed in the literature, but whose treatment has not always been consistent. These problems include: the interrelations between predictive and planning models of urban development; the transition from theoretical concepts to the identification of goals in the urban growth process; finally, the question of levels of aggregation in model building.

The first problem is typical of the study of urban development; this is one of the few fields where parallel spatial predictive and planning models are formulated. Planning models increasingly use predictive submodels; the latter are either simplified versions of original theoretical constructs, or specially designed schemes which are usually eclectic in relation to existing theoretical approaches.

The second question concerns what could be described as a typical contemporary formulation of research objectives. Modern urban research should produce theoretical concepts, as well as operational models stemming from these concepts. It should also become more important in planning. In reality, numerous factors, including some characteristics of descriptive generalizations and organizational and decision-making factors, frequently prevent the occurrence of stage two and, particularly, three.

The last question pertains to research prospects, and to the role of the macro- and micro-analytical predictive and planning approaches to urban models. At present the majority of empirical models belong to the first category. The micro-analytical approaches have not so far been able to offer operational, and at the same time, reliable, criteria of choice and individual preferences (see I. Lowry 1965). Recent attempts to develop the theory along these lines have shown that the methodology of predicting and programming the future urban structure may gradually incorporate an increasing number of micro-analytical postulates.

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CONTEMPORARY FORMS OF SOCIAL ORGANIZATION OF PRODUCTION AND THE DEVELOPMENT OF TOWNS

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The forms of social organization of production have a great influence on the development and distribution of towns and urban systems. The scientific technological revolution accelerates the development of these forms, increasing their influence on the geography of production and on the process of urbanization. These interrelations have not yet been sufficiently investigated. The authors do not presume to cover this problem fully; rather they propose a schematic analysis.

Concentration, specialization, cooperation and integration are all processes in the organization of production which occur simultaneously, and together have a dialectically conflicting influence on the development and distribution of towns.

The concentration of production, as distinct from agglomeration (i.e. spatial concentration)[1] is found above all in the growth of the productive capacity of individual enterprises (and particularly with the growing capacity of individual aggregates).[2] The concrete forms of the influence of concentration on the distribution of production are linked above all to an increase in the absolute scale of transport works (with an accompanying reduction in the labour costs). The following trends, directly connected with the development of towns and the formation of urban systems and networks, are the geographical results of the concentration of production:

(1) The radical change in the geography of deposits of raw materials. Due to the concentration of production it is rarely convenient to exploit the numerous, suitably located, but small sources of fuel and energy. At the same time the concentration of production permits the exploitation of resources which may be defficult to obtain (sometimes of low quality), provided they are sufficiently large.[3] On the whole, this is a progressive tendency. But one should not overestimate this; the concentration of industry leads not only to the opening up of new resources in new regions, but also to a passing over of small deposits, even though they may be of a high quality and located near markets, only because of their small volume. Thus, one results of the concentration of the extractive

[1] The agglomeration of production is one of the regular results of the combined activity of all the noted forms or social organization of production.

[2] The economic nature of the concentration is well known. Only one of its forms is noted here — that which most clearly shows the difference between concentration and agglomeration.

[3] This tendency is clearly apparent in the international division of labour.

industry can be an increasing distance between extracting and processing. In many European capitalist countries in the 1960's, this distance reached huge, previously unheard dimensions. Two main features characterize the changes in the distribution of the extractive industries: (a) a gradual transformation into regions of high territorial concentration of natural resources together with a possibility of creating very large extractive enterprises; (b) in the most developed regions the opening up not only of high and medium quality resources, but also of the large reserves of low quality resources. Because of this the average capacity of extractive enterprises in newly developed regions is higher than in the older industrial areas. Therefore in newly developed regions extraction is one of the most important factors in the growth of new towns. At the same time the magnitude of the enterprises and the large numbers they employ are the foundations of the town ensuring a population of more than 20,000. Extraction is a much less important city-forming factor in the older industrial regions. But when it takes place the town usually has less than 20,000 inhabitants.

The concentration of production draws basic processing closer to the place of extraction (production) of fuel and mineral raw materials (both in the country as a whole and in its zones and macroregions). This primarily lead to an improvement in the mineral raw materials, and also to the basic processing of forest and agricultural raw materials. This factor influences the development of the urban network.

(2) The concentration of production tends to geographically separate the labour-consuming and capital-consuming branches. Despite the opposite influence of certain other factors (notably, possible migration), this tendency appears, because with the growth of the concentration of production, the distribution of the labour-consuming branches largely depends on the distribution of labour resources. The capital- and raw material-intensive branches do not depend so much on this factor, but even here this dependence increases with a growing concentration of production.[4] All this suggests that in the near future the growth of the concentration of production in any branch will make labour a more important factor in their distribution. Of course, this will be counteracted by the increase in social effectiveness of labour, but this will not neutralize the trend mentioned above for a long time yet. All this must be considered when analysing the location of production in general. This type of analysis is particularly important for the distribution of large enteprises which have high labour costs. The labour factor attracts such enterprises to densely populated regions and to the large towns within these regions. This factor may also create important new centres which can recruit labour from surrounding regions (the Togliatti, Nizhnekamsk, etc. types).[5]

(3) Concentration of production in one branch of the national economy leads to concentration in the others. Thus this development in industry inevitably leads to a similar process in transport, agriculture construction and in non-

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[4] This is true if we consider the achievements of scientific-technological progress. Despite the growth in labour productivity and a decrease in labour costs, the absolute number of those employed in individual enterprises continues to grow. As a result those branches which are traditionally considered to need little labour, now typically show a considerable increase in the numbers they employ and a high spatial concentration. This takes on practical importance in sparsely populated areas where the development of new industry usually requires a lot of outside labour, and thus great expense in maintaining these new workers.

[5] The size of available labour reserves in particular small, and even in many medium size towns, is too small to act as a gravitational factor for large modern enterprises.

production activities. Similarly, these branches, individually and collectively influence industry and each other. The effect of concentration in individual branches of industry is also subject to this dual influence. Essentially this is the objective cause of the concentration of the economic foundations of towns, of the territorial concentration of population, and ultimately, of the rapid growth of towns. At the same time this process transforms a small number of suitably located large towns into centres of agglomeration or gravitation (in poorly developed areas, local systems of towns evolve around these centres of gravitation; in long settled regions, with well developed communications, regional systems evolve).[6] In this way the number of large towns having a large "potential distribution" is curtailed.[7] Concentration increases agglomeration in various fields of production, helps to form territorial links and production complexes, and following on from this, it helps create the preconditions for the preferential growth of large towns.

Ultimately, the concentration of production increases the concentration of population. This is manifested in various ways. First, the location of just one large enterprise in a small urban settlement usually greatly increases its population (sometimes, many times over). Therefore one must look at the small urban settlements separately, taking into account the necessary conditions for their "stabilization" or conversely, their rapid growth. It is easy to make important mistakes when identifying and evaluating these trends if one does not make this differentiation.[8] Second, the concentration of production leads to the territorial integration of settlements, and this in turns speeds up the formation of agglomerations and urban systems. Third, as a result of the concentration of production, the role of towns as centres of "gravitation" becomes more important. This means that the distinction between towns with growth "prospects" and those without, at a given stage of development, is even more apparent.[9]

Specialization and cooperation are two mutually linked and interdependent forms of the organization of production. On the one hand they strengthen concentration and thus become factors in the localization and agglomeration of production. On the other hand they make the existence of small and medium size enterprises possible; this increases the number of (equally) optimal locations and thus allows the dispersion of production, i.e. a planned control of the process of agglomeration.[10] The economic nature of specialization and coopera-

[6] Some problems about the gravitation of production are discussed in F. D. Zastavny's book, *Ekonomicheskiye problemy razvitiya territorial'no-promyshlennykh kompleksov* (Economic problems of the development of territorial-industrial complexes), Lvov 1969.

[7] On the potentials of distribution, see B. R. Pavchinski, O problemakh razvitiya malykh i srednikh gorodov yuzhnykh oblastei Severo-Zapadnogo ekonomicheskogo raiyona (Problems of the development of small and medium size towns in the south oblast's of the NW economic region), in: *Doklady otdeleniy i komissiy Geograficheskogo Obshchestva SSSR*, 11, Leningrad 1969.

[8] In particular the role of small settlements in forming an urban network may be overestimated. In the USSR from 1/5 to 1/4 of urban settlements with up to 10,000 inhabitants are fast growing ones, but at the time of analysis these were still classified as "smallest". However, in the near future they will come into the next highest category and will probably continue to grow (this can be noted in many urban settlements with between 10,000 and 20,000 inhabitants).

[9] Of course, an evaluation of a town's growth perspectives changes with time. Sometimes a town may begin to grow rapidly against the given moderate forecasts. However, in most cases evaluations of the possible growth of towns for a given forecasted period are correct; the errors which sometimes occur are moinly overestimations, not underestimations of the possible growth of particular towns.

[10] By the term "equally optimal" locations we mean those locations whose different economic effectiveness are either unimportant or undefined at a given level of economic theory and practice.

tion lies in increasing the labour productivity and reducing production costs. Their technological nature lies in the possible spatial separation of the processes of production and in creating conditions for a greater effectiveness in each stage of these processes. It is possible to separate the processes of production by very large distances; sometimes the same operation can be carried out both in neighbouring enterprises and in those separated by hundreds or thousands of kilometres. From this point of view, different types of specialization contribute differently to the creation of economic foundations of towns.

Product specialization often leads to a further growth in the concentration of production and to an inncrease in its spatial localization. Specialization may give rise to huge enterprises employing tens of thousands.[11] In many cases it increases the attraction which either markets or areas — having the necessary qualified labour — have for production. Product and technological specialization can also lead to the emergence of large enterprises, but more often to large branched production complexes. Tens and sometimes hundreds of enterprises of many sizes form complexes which are either product — or technologically — specialized. However the end product is produced in one main factory. Usually these types of specialization lead to the establishment of enterprises of all sizes. Taking into account that automation and mechanization increase the effectiveness of narrow specialization, one would expect that future product and stage specialization will favour numerous narrowly specialized enterprise employing few workers. For these enterprises there will be few locational alternatives; moreover these will be of approximately equal suitability. Thus if product specialization favours the concentration and agglomeration of production and affirms its location, then other types of specialization tend to increase "locational freedom", making possible the territorial separation of the processes of production. It is thus possible to control and limit the agglomeration of production, and consequently the growth of large towns. The economic activation of small and medium size towns can similarly be controlled (especially by setting up branches of important enterprises within them).

Integration leads to technico-economic and territorial unity between the various branches of industry. This unity by no means requires the location of a combine in one industrial area. These areas may be separated by large distances, but there must be lasting production links between them. A combine, the result of the linking-up of various enterprises, is established only when such solid territorial-production links come into existence. Integration leads to a further agglomeration and spatial centralization of production. Here, a very important feature of integration is its strong influence not only on the location but also on the linking up of production. There may be combines of all sizes. However integration favours very large enterprises. In agreement with the law of agglomeration, the larger the combine the greater its attraction for a whole series of enterprises with a different type of production to these making up the combine. Usually the economic advantages of integration are large enough to overcome such disadvantages as growing transport costs. In the future, once the large combines have been "permanently registered", they will themselves become stronger agglomerations of production. This is why integration will be the cause of a rapid growth of a number of towns and of their growing beyond their "optimum" size. Thus integration is one of the most important factors in the concentration of production in large towns.

[11] This is particularly true of the leading enterprises of large branched complex. Whereas the lower "stages" in such complexes may be made up of enterprises of various size, the chief enterprises are usually very large.

In capitalist countries where only a limited control of the growth and distribution of production is possible, the force of agglomeration results in a permanent conflict between large and small towns. Under socialism, the continuing agglomeration of production does not stop, but this process can be controlled through a rational linking up of the effects of all four forms of the organization of production on its distribution. From this point of view the question of the influence of these forms on the distribution of particular branches of industry deserves special attention. This problem is usually looked at from two sides. It interests town builders and planners in connection with analysing the city-forming role of individual branches of industry. Economists and economic geographers more often study the influence of each form of organization of production (more rarely, their combined effect) on the distribution of the separate branches. There is, however, a third side, which is interesting from the point of view of estimating the possible control over the growth of towns; this is the effect of the law of agglomeration on individual branches of industry.

The iron and steel industry, chemical production (for example, large oil refineries, etc.) are not only closely subject to the law of agglomeration, but what is most important, are themselves strong agents of agglomeration of production. These industries attract tens of other enterprises, sometimes very large ones, becoming the nuclei of agglomerations; they also create the objective necessary conditions for the formation both of industrial networks and regions and of the growth of large towns.[12]

Non-ferrous metallurgy, fuel, forest, cement and the food and light branches of industry show a weak tendency to agglomerate. First, they typically employ few people in individual enterprises and combines. Second, they are distinguished by a dispersed distribution. Third, the enterprises of these branches of industry are rarely strong agglomerators (only the largest enterprises can act in this way). These branches often "create" small and medium size towns or whole clusters of small towns. In weakly developed areas the enterprises of these industries (especially mining and wood industry) form the basic framework for the early stages of development. These industries rarely form base for the growth of large towns; if they do then this is almost always through links with other industries. The many branches of the machine-building industry also show only a weak tendency to agglomerate, particularly those having detailed or stage specialization. Many enterprises which are specialized in this way can successfully function in small towns and urban settlements, although far removed from neighbouring enterprises.[13] Those industries which are typically specialized by product, tend to agglomerate more strongly. However, even here there is not merely a large number of really big enterprises; wider cooperation gives these enterprises a certain freedom of location (this is also true of some chemical industries, of the building material industry and of the glass and

[12] If we take Novokuznetsk or Karaganda as examples it may be objected that these are not typical; in both these towns the metallurgical industry "came" to the coal deposits. There are, however, towns which became metallurgical centres far removed from coal and iron ore deposits. Thus in Cherepovets the metallurgical factory was the first large enterprise. Its power of agglomeration can be seen in the growth of the population: 32,000 in 1939, 92,000 in 1959, and 189,000 in 1970.

[13] These enterprises are often located even in small towns, although they must not be too far from the main enterprise with which they are linked. This is why many large machine-building centres are surrounded by a ring of industrial units which are narrowly specialized.

precious ceramics industries. Most machine-building enterprises have many possible locations.

Thus, from what has been said it follows that each functional type of town has on optimum size, governed above all by its structure of production.

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THE REGION FORMING ROLE OF LARGE AND MIDDLE SIZE TOWNS

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We are looking at the integral economic region[1] as an objective economic category, the essence of which is a regular territorial-production uniformity formed in the process of the territorial division of labour. The region-forming is linked with two opposing tendencies: (1) the continual apportioning of new branches of production and their territorial separation; (2) the strengthening of mutual territorial-production links between branches. The first tendency gives the territorial-branch structure of regions its specific character, the second, the development of a uniform system of integral regions.

The basic region forming factor is the appearance and development of the region-forming "core". In socialist countries this role is taken up by territorial-production complexes[2] which are already formed (or are being formed), which can be appropriately classified; this role is also taken up by region-forming transport "arteries". The basic criterion of regionalization are territorial-economic links, the chief factor being the proximity of an area to the "core" or the "artery". Therefore transport is one of the more important region-forming factors; it is the foundation of the economic links among different parts of the region (especially between the "core" and the periphery).

Large and middle order towns play the most important role in the formation of regions. They are the centres of concentration of larger industrial and building enterprises. Various types of production combines, construction organizations and other units of economic administration are found in these towns. In the large and middle size towns one usually finds a concentration of enterprises and institutions in the non-productive sphere, serving not only the urban but also the rural population. The role of the large and middle-size towns in their hinterland has greatly increased thanks to the existence of the many administrative functions possessed by the capital towns, towns of the "capital" type, *oblast* centres and so on. In all these cases the most important town in the process of the territorial distribution of labour gradually becomes the nucleus of the territorial production complex, taking in both the *town itself* and its peripheries.

Proximity of the territory to the town and good transport communications with it, greatly change the value of various region forming factors. Local

[1] The socialist integral region is a territorial part of the national economy, characterized by a historically formed economic community, and by given conditions and perspectives of the development of production.

[2] The territorial-production complex is a regular totality of mutually linked elements of production, which form a territorial and economic unity.

natural conditions and resources (e.g. low-grade fuels; non-ores esp. building materials; raw materials; flood plains) can aquire great significance. The importance of transport arteries increases in the economic development of the area surrounding the town, due to the mainly *sectoral* (sometimes linear) character aquired by the locations of production. Thus the role of all region-forming factors in the zones gravitating to the high and middle size towns depends on one dominating factor — the position of an area in relation to the *region-forming* centre.

In the 1960's the rapid industrial development in the eastern regions of the USSR was accompanied by a rapid growth of many towns of all sizes in the European zone (except very large towns in which new industrial construction is restricted). The decisive role here is played by scientific-technical progress, particularly the further intensification of production and increased industrial specialization and cooperation. Sectional and technological specialization have particular importance in that they greatly decrease the proportional costs of labour. This is most apparent in machine construction where many new specialized factories have sprung up. The changes in the territorial organization of production in these economic regions are particularly marked where previously there was a heavy concentration of industry in only a few towns (Leningrad, Kiev, Gorki, etc.).

Recently in the USRR there has been an intensification of the process of forming new industrial networks, and of the transformation of old, rapidly developing industrial centres into new nodes. In the latter, links between the subsidiary industrial branches and neighbouring agricultural areas become important, whereas contacts between the specialized branches are set up much later. In new industrial nodes set up "in new areas", the more important proportions of, and links between industrial works of a given type of production are defined from the very beginning.

Industrial nodes are usually based on high and middle size towns as well as the small urban settlements surrounding these towns. The leading role in this progressive process belongs to the largest towns, which possess a wide variety of industry, a developed non-production sphere, and which are centres of science and technology. An important role is also played in large, medium, and occasionally, in small urban settlements, by the formation of branches of large enterprises or production combines, of which the main ones are concentrated in only a few large industrial centres. For example, many Leningrad enterprises and production combines (there are over 50 production combines in the city) have set up branches in Novgorod, Pskov, Vielkii Luk, Petrozavodsk and several small towns. Many of these branches have now become independent factories but still have strong connections through co-operative networks with their former parent enterprises.

Leningrad is a centre of one of the biggest urban agglomerations, and together with its nearby towns and settlements which are strongly linked with it, belongs to one of the most important industrial nodes in the country. The basis of this industrial node is the four-million population of the city, its multi-branched industry and many scientific and cultural functions; the city fully deserves to be called a town centre of the "capital" type.

For a long time the industry of the region around Leningrad developed slowly, the area remaining largely agricultural. Because of Leningrad's influence, a regional territorial-production complex is now developing in this area. The boundaries of this complex do not coincide with the existing administrative and national-political units. Within this complex we find not only the Leningrad, Novgorod, Pskov *Oblasts* and Western Region of Vologod, but also

the North-Eastern part of Estonia (with Narva) which is well known for its slate-quarries, and Prionezhe (with Petrozavodsk) situated in the Karel ASSR. The territorial structure of this complex depends as much on the considerable economic influence of one of the largest industrial nodes as in its non-central position in the North-Western area of the country. Six industrial nodes have been planned for the Leningrad *Oblast*. The Kirishk oil and power industrial node is developing rapidly and the foundations of the Tikhvinsk and Kingisepsk industrial districts are being established. The Cherepovetsk metallurgical-chemical complex continues to grow. Novgorod, Pskov, Wielkii Luk and other towns are being further industrialized with the short term aim of group concentration of industrial enterprises and the long term perspective of forming industrial nodes.

The territorial organization of industries in the Ukrainian SSR is also based on the development of industrial nodes. One of the largest is the Kiev network. The capital city, with more than one and a half million population is the basis of this network. It is a multifunctional town with many strongly developing types of industry, but it is also a great centre of culture, science, trade and administration. Until recently, lacking heavy industry, the regions and *oblasts* around Kiev were mainly concerned with processing agricultural raw materials. The building of plants in towns and settlements near Kiev (Brovary, Vasilkov, Fastov), in more distant parts of the Kiev *oblast* and also in neighbouring *oblast* (Zhitomirsk, Chernigorsk and Cherkask) used to depend on their cooperation with the industrial complex of Kiev. This led to the reinforcement of mutual production links between urban population units, and to the development of a *regional territorial-production complex* consisting of the Kiev, Zhitomirsk, Chernigorsk, Byelaya Tserkov, Umansk, Berdichevsk and Priluksk industrial nodes.

The regional territorial-production complex can be approached in terms of being either a *regionally branched* or an *integral* complex. In the former we find plants of separate industrial branches grouping themselves around larger production centres, which together form associations (*kusty*) of machine construction, chemical industry and so on. The integral complexes and their corresponding economic microregions form territorial-production units. These are made up of *elementary, compound* and *central* complexes, which depend on sources of raw materials and markets for surplus production. Corresponding to each of these are hierarchically subordinated microregions, sometimes called *basic* (*nizovie*), *small* (*drobnie*) or intra-*oblast*. In turn, a difined territory corresponds to each level of microregion; groups of villages which usually take in the area of several agricultural enterprises correspond to the basic microregion; individual, or small groups of administrative regions, linked to a medium or large town or to transport arteries make up the small microregion; larger groups of administrative regions distinguished by a single type of agricultural development, and by being linked to larger region-forming centres make up the intra-*oblast* microregion. The system of microregions does not always appear in its entirety in all the regional territorial-production complexes. Microregions of a middle or higher order are found depending on the level of economic development, the existence or non-existence of a large region-forming centre and the density of the transport network.

In order to explain the level and character of the links of large and medium towns with the "small" microregions, it is useful to subdivide its territory into zones of gravitation-immediate, intermediate and peripheral. In the immediate zone, the large influence of the town on its adjacent territory is expressed through work and cultural links, whereas the peripheral zone is no longer

characterized by commuting since local administrative and economic centres are becoming more important. The rapid industrialization of middle and many small towns in regions of this type has led to a clear functional subordination and a hierarchy of urban settlements. This is confirmed by the changes in population of middle size towns to the very largest, in the Leningrad regional-production complex from 1926–1970. Whereas in 1926, apart from Leningrad, there was not one town of even medium size, today there are four large and five medium towns. The difference between the largest town and other large and middle sized towns is not as clear cut as at the beginning of the socialist industrialization of the country. Characteristically, Leningrad is growing much more slowly, and most of the large and middle sized towns more quickly than the total urban population of the region under discussion.

TABLE 1. The results of trips made by trade enterprises

To the towns from the towns	Kiev	Byelaya Tserkov'	Pereyaslavl' Chmel'nitskii	Yagotin	Fastov	Vasilkov	Skvira	Rakitnoye
Kiev	0	26	6	45	5	7	0	0
Byelaya Tserkov'	148	0	0	1	1	0	4	3
Pereyaslavl' Chmel'nitskii	22	0	0	33	0	1	0	0
Yagotin	36	0	0	0	0	0	1	0
Fastov	167	6	1	0	0	1	0	0
Vasilkov	179	4	0	0	1	0	0	0
Skvira	26	12	0	0	0	0	0	0
Rakitnoye	12	0	0	0	0	0	0	0
Total	590	48	7	79	7	9	5	3
Number of attracting centres	7	4	2	3	3	3	2	1

Usually, many final stages of production are concentrated in the largest towns, which testifies to the development of a definite *productional* hierarchy in the regional territorial-production complex. For example, in the Kiev *oblast*, more than three quarters of the intra-*oblast* haulage in the food industry and more than half of the products of the machine building industry is directed toward the capital of the Ukraine. A clear hierarchy can also be seen in the *non-production* sphere. In the larger towns there are concentrated institutions and organizations with services of the highest order (so called, sporadic), including theatres, museums, central libraries, an extensive network of higher schools and technical colleges, specialized trade centres, larger hospitals, etc. This gives them a leading role in the service system of a particular territorial-production complex. There is a preponderance of institutions with these sporadical services in the large and medium towns, which usually meet the needs of both the urban and rural population. According to the hierarchical structure of the territorial-production formation and the service systems one can see mutual links between population localities and not only the large towns, but also between themselves. Depending on the intensity of these mutual links and the type of area surrounding the large towns, one can *establish a hierarchy and level of development of the settlement system*. For example, using the results of an investigation of

trade enterprises in some urban settlements of the Kiev *oblast*, carried out by the Kiev Institute of Scientific Research and Town Planning, one can illustrate the hierarchical interdependence of the system of centres of population. For this purpose, the results of trips made by trade enterprises are given in matrix form (Table 1).

By far the most trade is directed towards Kiev, and so it is a higher ranking town than all the others. Using the theory of graphs and the data on the inter-relations we consider that in the Kiev *oblast* there are two main region forming centres, Kiev and Byelaya Tserkov' and that Byelaya Tserkov' is functionally subordinate to Kiev. The study of the region forming role of Kiev is based on an analysis of the chief functional interrelations (production, trade distribution and labour) of the central town and of the extensive surrounding areas of the Kiev, Zhitomirsk, Chernigorsk and Cherkask *oblasts*. Having influence over all the urban and rural settlements linked to it, Kiev forms a *basic level economic region*.

From a preliminary survey of the data, the directions and intensity of the main types of inter-relations have been delimited. To statistically assess the intensity of the links the following indicators[3] were selected: the size of the links (the volume of freight, the number of purchases, the number of those employed from out-of-town, the value of goods and so on) as calculated for 100 inhabitants of the settlement units which surround the central town; the density of the links (calculated for 10 km^2). From these indices one can work out the trends in the changes of the intensity of the links, depending on the distance from the central town. The most important trend is that the intensity of the links decreases with distance from the central town; this can be represented by the following relationship:

$$I_i = AR_i^{-n} \tag{1}$$

where: I_i = the intensity of a particular link between the ith population and the central town.

R_i = the distance from the ith settlement to the central town.

A and h are constants characterizing the regional state of the links between the central town and the system of settlement units.

A study of the production, trade and labour (commuting) links shows that each of these has a characteristic sphere of operation. In order to prove this, a mean radius of operation for each type of link was calculated using the following equation:

$$R_i = \frac{\sum_{i=1}^{n} I_i R_i}{n} \qquad n = 1, 2, 3... \tag{2}$$

where: I_i = the intensity of a particular type of link between the ith settlement and the central town.

R_i = distance in km from the ith settlement to the central town.

Calculations done for Kiev showed that the mean radius for labour is 43 km, for trade, 76 km and for production, 167 km. For practical purposes, especially for working out regional plans, it is necessary to define the composite boundaries of the zones of operation of the system of links. For this purpose indices of

[3] A system of indicators and proposed methods of investigation for determining regions of influence have been worked out by N. F. Timchuk by studying the regularity in the intensity of links.

link types which have various interpretations are replaced by commensurate ones by which one can carry out simple mathematical conversions and which do not distort the true picture of the system of links. These requirements are fully realized by the ratios below:

$$a_i = \frac{A_i}{\sum_{i=1}^{n} A_i}: \quad b_i = \frac{B_i}{\sum_{i=1}^{n} B_i}: \quad c_i = \frac{C_i}{\sum_{i=1}^{n} C_i} \tag{3}$$

where: a_i, b_i, c_i are the relative values of the production, trade and labour links of the ith settlement unit with the central town.

A_i, B_i, C_i are the absolute values of the production, trade and labour links.

ΣA_i, ΣB_i, ΣC_i are the sums of the values of these links.

In defining the composite boundaries, the magnitudes of the various types of link which have been referred to are summed for each of the surrounding settlement units:

$$L_i = a_i + b_i + c_i$$

Using the summed values of the system of links, L_i is defined as the mean radius of the surrounding region (Formula 2).

For Kiev the mean radius of the area of composite relations between the central town and its surrounding settlement units is 85 km.

Up to 60 km one finds the suburban planning zone with an area of about 12,000 km². This area is characterized by an intensive use of land for the needs of the town, for supplying it with agricultural products which are perishable and cannot easily be transported. It is also characterized by the spacing of urban enterprises and organizations, areas of recreation and of engineering and transport constructions.

Kiev's influence is most intense in this area. It is evident in the economic and demographic structural changes, in the network of settlement units, and in the distribution and specialization of industrial and agricultural production.

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FEATURES OF THE FORMATION OF TOWN NETWORKS IN FRONTIER REGIONS

Lev N. Karpov and Kiril P. Kosmachev

One of the basic elements in the development of spatial economic systems of all types and scale is the economic "opening up" of lands with the aim of forming new elements of productive forces. With the development and increasing complexity of this "opening up" process, spatial systems change their form; we can thus consider this "opening up" as one of the most important geographical processes. This process aims at extending and reconstructing the "social economic space" — "the area in which man lives, works and rests".[1]

An important part of the process of forming a territorial economic structure is the use of different types of natural resource and their territorial links.

The relative exhaustion of resources in long-settled regions of developed countries, caused by the greatly increased demand for them, stimulates a more rapid development of areas in these countries which are not yet settled. In many leading capitalist countries this process is greatly influenced by the desire to create "reliable" sources of raw materials in the "politically stable" regions of the world. Thus, through developing their own new regions, the economies of the developed capitalist countries become more or less independent of traditional sources of raw materials, i.e., former colonies and dependencies.

The community will always determine the way in which an area is settled. However this settling process is largely affected by natural conditions, that is, how it "accepts" the influence of the community, to what degree the work of man can accumulate and be preserved for a long time. Thus the opening up of an area is the result of two related processes — that of nature and of production. The development of an area during which a framework for the distribution of productional forces emerges, depends on the combined effects of these two processes. Towns are a very important part of this framework: they are the main elements of the spatial structure of the economy.

An extreme form of the settlement of new areas is man's economic expansion into uninhabited areas and the creation of a network of new settlements which form the outposts of the development of natural resources. In the last 25 years about seven hundred new towns and villages have been built in frontier regions such as North and West Canada, North, Central and Western Australia, Alaska, Greenland and Northern Scandinavia. A similar number have been built in the new regions of the Soviet Union. The intensive exploitation of resources in these new areas of the Soviet Union is based on the latest scientific

[1] S. Leszczycki, Perspektivy razvitiya geograficheskikh nauk (Perspectives of the development of geographical sciences), *Vestnik M.G.U.*, ser. geogr., 1968, 5, p. 12.

and technical achievements, modern methods of production, qualified manpower and a progressive system of division of labour among individual regions.

In developed countries the role of these new regions in the territorial division of labour should be based on a narrow specialization in the production of raw materials and semifinished goods. Most of the large enterprises established in new regions outside the USSR have achieved high productivity through the newest scientific and technical achievements and the mechanization and automation of production. However, heavy investment, essential for practising modern methods of production, only pays off with large scale production. This means that if these enterprises are to achieve their highest profitability there must be a very large output of production. The small investment in the new regions, when compared with that in the settled regions of a particular country, is nevertheless important not only in the national production of a country, but also for world production. As a result the majority of these enterprises have always been more concerned with world markets rather than home markets.

The size of towns and settlements built in the new regions is closely connected with the optimum size of the regions' enterprises. The building of a new outpost-town or the opening up of a region is preceded by large scale and long term work on the technical-economic framework for this new centre. The development of an enterprise or production complex is continually revised. A very important role in such a scheme is played by the establishment of mutual links (mathematically calculated) between (a) resources; (b) the optimum size of a new centre; (c) the size of the present and future home and world markets.

The development of most new centres in developed countries is linked with the modern technological revolution. The post-war technical revolution has directed profitable investment to the resources of undeveloped regions, i.e., it has increased the technical and economic potential of these areas. Here, modern technology takes on a new significance.

Since extreme climatic conditions and under-population of new regions makes labour costs (and especially of highly qualifed personnel) much higher than in the populated regions, the problems of increasing labour productivity through technology and of establishing enterprises of optimum size, become very important. In new regions, modern technology replaces costly labour, and it is therefore used more effectively than in developed regions. The realization of some post-war projects for developing resources would have been impossible without the help of modern technology. For example, the establishment of many mining centres in Northern Canada and Western Australia in the post-war period was linked with a marked increase in labour productivity and a decrease in the cost (for example a 20-fold decrease) of geological surveying, by using the more effective aerial photographic methods in magnetic surveying.

The new towns and industrial settlements which sprang in the new regions of developed countries in the post-war period usually have from 5000 to 10,000 inhabitants. Nearly all the towns with over 10,000 inhabitants combine production functions with those of trade-distribution and administration; these are the main centres of these large areas which are rich in resources.

On the whole the hierarchical location of settlements is different to that in the settled regions. There are very few large towns which are trade-distribution and cultural-administrative centre either for a whole region or for a group of new resources-oriented towns located near raw materials. Because of this the typical lack of large towns, the services of all the new centres are largely supplied by large towns in the settled parts of a country; these may be situated hundreds, or even thousands, of kilometres away.

Since the development of new regions is above all linked with the exploitation of natural resources (e.g. mineral deposits, forests, virgin land and distant sources of HEP), at least half of the new centres are highly specialized. Experience has shown that the implementation of the majority of new industrial construction projects must be preceded by a study on how to link up production in the new areas. There are usually one or two highly specialized enterprises, forming so-called "reduced" production complexes. As a result there are few types of towns in these areas; seven types of centres may be distinguished.

(1) Centres of extraction and processing of metallic and non-metallic ores;
(2) Centres of extraction and processing of oil, coal and gas;
(3) Centres of the forest and food industries;
(4) HEP centres;
(5) Transport centres;
(6) Scientific centres;
(7) Trade-distribution and administrative centres.

This classification was done using data on the development of the Northern regions of the USSR and the post-war censuses of Canada, Australia, Alaska, Scandinavia, and also numerous monographs and articles (including foreign ones). This classification was above all based on an analysis of the economic base and structure of the towns investigated. The functional structure was the most important aspect studied. Since the dominating functions of new centres are industrial production, transport and energy production, the classification must be based above all on the occupation of those employed in industry.

The chief feature of the post-war development of frontier regions in developed countries has been the solution of the problem of "ghost-towns", which, until recently, have accompanied each exploitation of a source of raw material. In many frontier regions the demand for labour during the period of construction is much greater (sometimes 10 times greater) than the requirements after these highly automated enterprises have been built. On the other hand, the focus of development, whereby towns are built near rich but small deposits of raw materials, in some cases makes it unnecessary to create large and permanent towns and settlements. Therefore in capitalist countries "mobile towns" are widely found; this is possible through the widespread use of caravans and trailers, which can be easily moved to other areas.

The desire to use modern scientific and technical achievements in new regions is increasing not only in the main production processes, but also in services, construction, repairs and so on. We can see in the example of the "mobile towns" how the effective opening up of new areas has increased through a greater use of "pre-fabs" and caravans. The use of tinned foods and other semi-finished products in the food industry and a greater use of spare parts in the technical services, are much more important than in the settled regions. Thus, in the new resource-towns in redeveloped areas, the progress made in goods transport is widely used for transferring works from regions with a high cost of production to those with a low cost. The post-war increase in the cost of qualified labour has led to a similar economic trend. Thus, in the new regions of industrial countries the extraction of raw materials and the manufacture of semi-finished products is being increasingly limited to large, capital, raw-material and energy (but not labour) consuming enterprises. At the same time the processing of raw materials is being increasingly moved to regions with more suitable natural conditions. In most cases these regions also have lower production costs in the main branches of the modern processing industry.

The analysis of the formation of networks of new towns, referred to earlier, suggests that in developed countries, the optimum size of new centres depends on the type of production, the size of resources (whether they are self-renewing or not), and so on; these standards were worked out both empirically and from the results of special scientific studies. In capitalist countries, a series of new resource-towns forms a kind of reserve of production for important but "unstable" raw materials such as oil. The functioning of this type of centre under the normal conditions of the capitalist market would not have been possible without, and the process was accelarated by the post-war developments in the national-liberation movements in those countries which traditionally supplied raw materials.

The necessity of opening up new regions of high natural value and the accompanying difficulties have led to the working out in practice of the so-called "wide approach" for solving problems of developing sparsely populated areas of these countries. This "wide approach" is one of subsidizing construction where raw materials have been found, creating an economic infrastructure, building of towns financed from the national budget, and using other methods to create a suitable climate for specialized investment in newly industrialized regions in underpopulated areas.

Thus in every country, the development of new areas is possible thanks to the creation of defined systems of urban settlements, with road networks — "a framework which forms the territory and gives it its configuration" (NNB, 1956).

A system of urban settlements in frontier region has several distinct features, namely,

(a) small centres and little differentiation between the elements of the system;

(b) weak links between "neighbouring" elements and permanent links with the distant primary towns;

(c) a lack of large monofunctional towns and many small resource-towns, whose network undergoes essential changes and rebuilding in line with the changes in the system as a whole;

(d) a linear system of towns, resulting from the plan of development.

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PROBLEMS OF DEVELOPMENT OF A SETTLEMENT NETWORK IN A REGION UNDER INDUSTRIALIZATION

ANTONI ZAGOŻDŻON

The selected problems of the development of a settlement network in an industrializing region[1] discussed below, are a fragment of the multitude of problems involved in the changes in a settlement network. The complexity of these selected problems consists in the fact that a settlement network can be altered very rapidly in an industrializing region; this complicates research considerably. It is for this reason that such a procedure must secure a method of approach that would permit both the identification of the types of changes involved and of their mechanisms, within a given region as well as a comparative analysis of various regions.

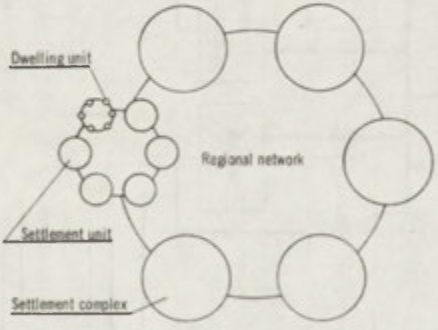

Fig. 1. A scheme of settlement network. After B. Kostrubiec

With the limited space of this study, it is not possible to discuss the problems involved at any length. Thus the scope of this work has been restricted to certain problems which are considered to be of major importance; these include:

— the general characteristic of changes occurring within a settlement network of a region of accelerating industrialization and urbanization; a consideration of the rate, dynamics and the mechanisms of these changes that make up a certain number of causes and consequences;

[1] The work was done by the author in the Department of Social and Political Geography of the University of Wrocław (and in the former Chair of Economic Geography of the Institute of Geography) under the guidance of Prof. S. Golachowski. Some of the research was conducted within the framework of the Committee for Research on Regions under Industrialization of the Polish Academy of Sciences. Some of the works have been published.

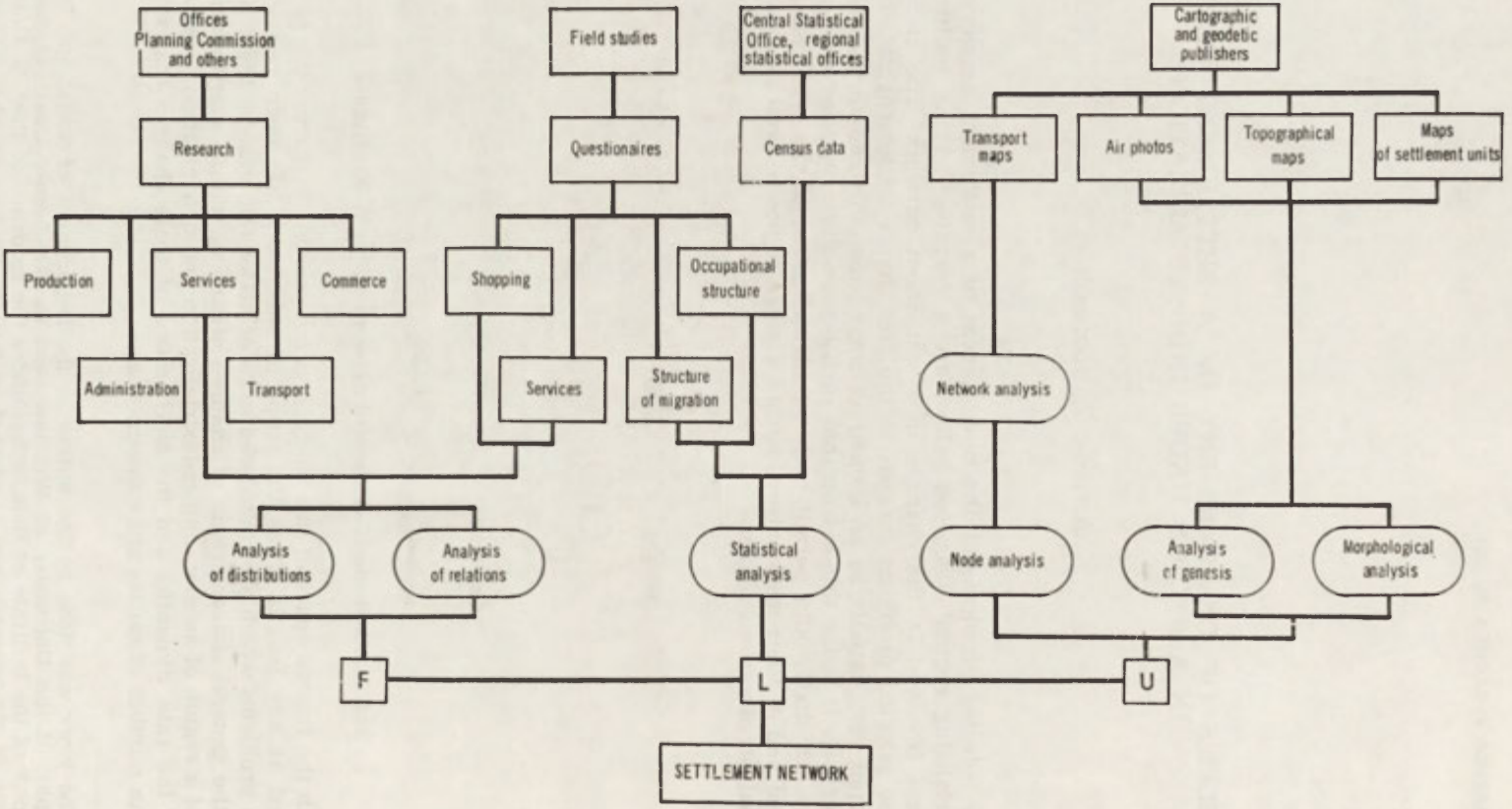

Fig. 2. A model of the settlement network study
F — functions, L — population, U — pattern

— a selection of certain methods and techniques which the author thinks are of prime importance in this subject; an inspection and discussion of some other examples may later bring about a standardization in the approach to these problems.

A settlement network may be defined primarily as a system of elements spatially arranged, hierarchically differentiated and functionally specialized. These elements form a certain system that functions in accordance with the economic character of the area; this is due to the different relations between the elements of a network. Elements of a network may be the individual settlements, or groups of settlements organized to form a sub-systems (Kostrubiec 1972; Fig. 1). One can speak of several types of units, as links in a network, viz.:

— settlement units of various size, status, scale, functions (ranging from the smallest rural unit to the large urban agglomeration);

— groups of settlement units that are mutually linked by different types relations, and which most frequently form agricultural service complex systems consisting of single villages and service centres, or agro-industrial complex systems;

— settlement complexes, as strongly integrated groups of settlements with distinct non-agricultural functions.

If one sees each of the network units (network links) as a system composed of elements of the functions of the population structure and of those of the so-called technical-spatial sphere, this will help in understanding both the complexity of the problems involved in such a network and the reason that make a considerable expansion in the research procedure necessary.

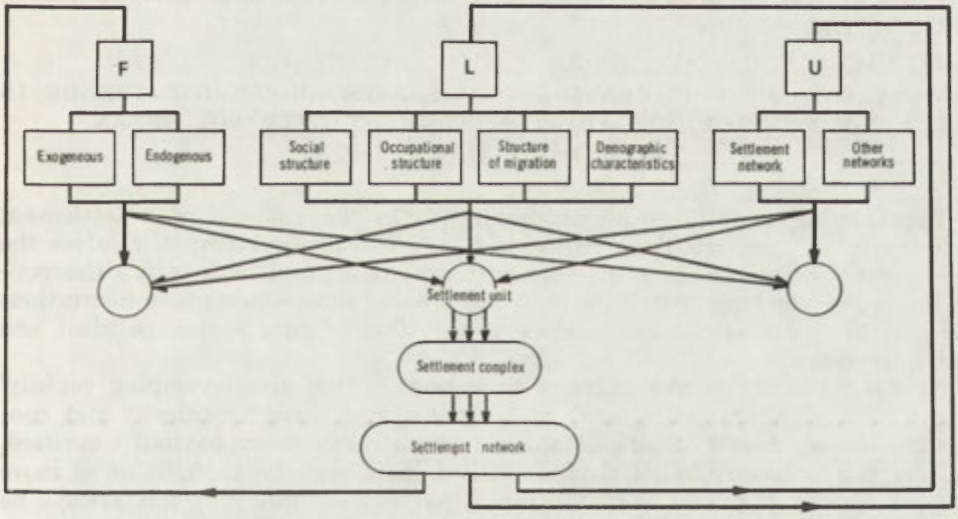

Fig. 3. Settlement network analysis in terms of: functions (F), population (L), pattern (U)

The essence of a settlement network, particularly when one is considering the rapid changes in the network, necessarily makes research complex if it is to encompass all the above mentioned elements (Zagożdżon 1968). Attempts have been made to illustrate this by using the so-called "breakdown diagram" of a settlement network (Fig. 2). This diagram comprises two types of system.

The first concerns the whole scope of the subject, and includes problems like the functions discharged, population and area arrangement (incorporating the morphology of settlements). These are represented in the columns of the diagram. The other system concerns the stages of research; these are represented in the lines (horizontal series) showing the individual phases of the study (beginning with the types of information or data, through the institutions involved, and up to the methods and techniques used in the research). The drawing indicates the various steps: collecting the data, direction of data circulation, and the successive stages of data processing.

The next diagram expands the above problems, and it represents a comprehensive analysis of the network (Zagoździon 1968; Fig. 3). In this diagram, the primary elements represent the individual research areas (F — functions, L — population, U — pattern). The research order (vector) derived from each of the above areas, is two-fold:

— independent, i.e., introduced separately into the individual links of a network; such an order is not contiguous with others,[2]

— simultaneous, i.e., introduced into the given network link at the same time as other orders.

The first case occurs when the aim of the research is to analyse a single problem, these analyses are usually of specific problems, such as the functions of dwellings (or of links of a higher order), the structure of the population, etc. It thus occurs when the researcher is looking at only one of the problems of his analysis, or at each of the problems in turn.

The other approach gives a more comprehensive analysis. It may also provide the basis of systems approach; sometimes it reveals not only the structure of a system, but also its functioning, as based on the appropriate (internal, external) relationships.

AN ATTEMPT AT FORMULATING HYPOTHESES ABOUT THE TRENDS IN THE DEVELOPMENT OF A SETTLEMENT NETWORK OF AN INDUSTRIALIZING REGION

Formulating hypotheses about the trends in the changes of a settlement network in an industrializing region is a larger scale problem; it involves the development of the entire settlement network. This problem is both a theoretical and a practical one, particularly at the present time, when many institutions are searching for settlement models to suit their future social, political and economic tasks.

So far research on the changes in regions which are developing rapidly[3] permits some general statements to be made, and some hypotheses and conclusions to be drawn. Some of them have already been partially verified. Despite this, it is my belief that not all of them may be thought of as more general regularities, and even for those that can be this may not always be possible.[4] Research conclusions may be compiled in two groups, differing according to approach.

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[2] An idependently introduced method of research may be derived out of the structure following an information having been obtained, also non-tangently with other orders.

[3] This research is being conducted in Poland by interdisciplinary groups, including the Committee for Research on Regions under Industrialization of the Polish Academy of Sciences.

[4] These comments are presented in this study for discussion.

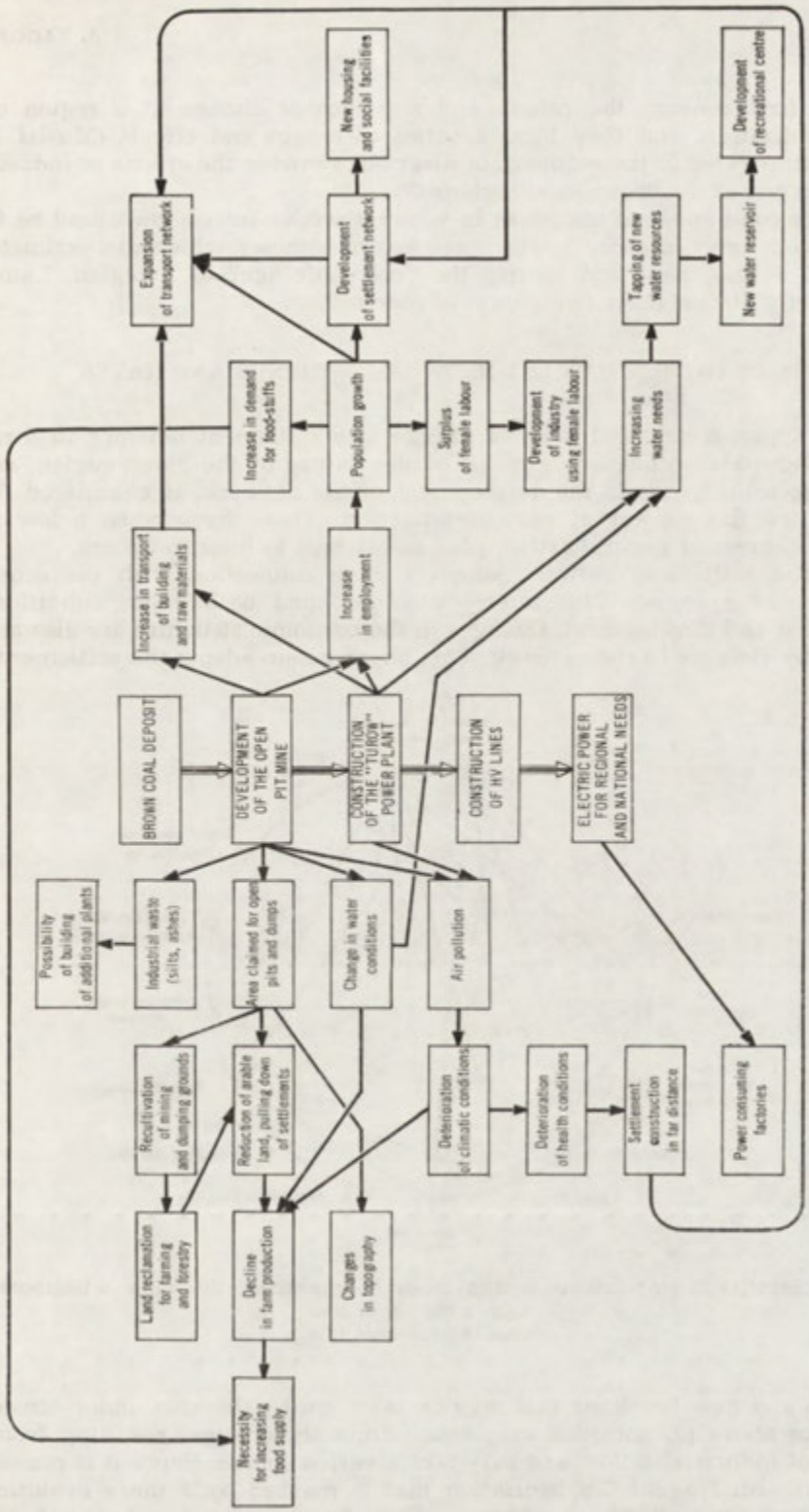

Fig. 4. Block model of the effects of industrialization, exemplified by the Turoszów region (after M. Musiał)

The first concern the ranges and sequence of change in a region under industrialization, and they form a series of causes and effects (Musiał 1971). This is illustrated in the sequence of diagrams showing the effects of industrialization in one of the brown-coal regions (Fig. 4).

The second apply to the phase in which a settlement complex may be found at a given time. In other words these are hypotheses which can estimate the state of development and specify the "economic age" of a region. Later we will briefly discuss these two groups of conclusions.

CHANGES IN THE SETTLEMENT NETWORK — TRENDS AND RATES

The types, trends and rates of change in a settlement network in a region under industrialization, are a result of the nature of the given region, and of the large-scale trends in the development of the network, as considered. These factors are the subject of our investigation. Those hypotheses below show various degrees of generalization, plus an attempt to interpret them.

(1) The settlement network shows a close connection with the economic structure of a region. This interrelation is found both under conditions of stagnation and development. Changes in the economic structure are also accompanied by changes in the network. This phenomenon adapts the settlement net-

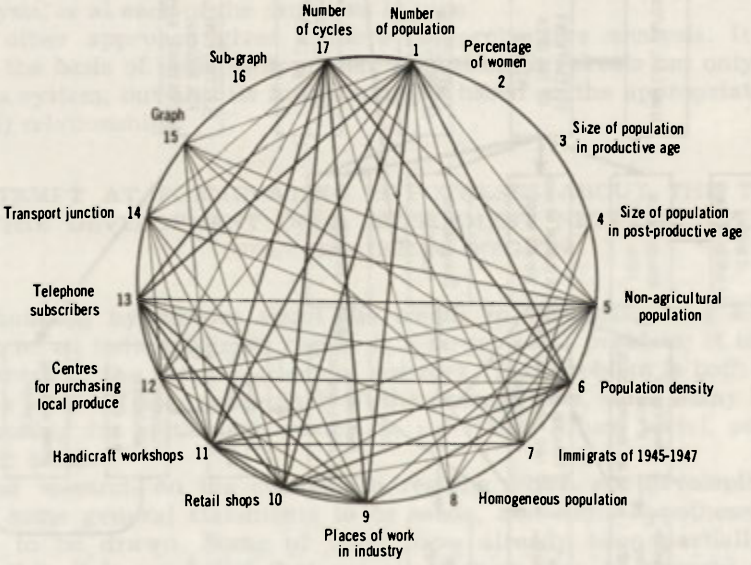

Fig. 5. Significant correlations within a set of characteristics of a settlement unit
0.500 – 0.700 — thin line
over 0.700 — bold line

work to any new functions that may be taken on by the area under consideration. The above phenomenon may result from the changes resulting from the impact of industrialization, and may take a varied course. Hence it is reasonable to distinguish "organic" urbanization that is marked by a more evolutionary course, and "controlled" urbanization which shows a more rapid rate of change.

(2) The evolution of a settlement network points to the presence at certain

stages, of specific states of equilibrium. These have a high conformability in the values of the indexes defining the functions of the settlements, their morphology and the structure of their population. One can verify this thesis by using statistical methods, e.g., correlation analysis which is concerned with the multi-featured characteristic of settlements. This has been done for one region (Zagoździon 1970). Correlation analysis requires no discussion, but one can at this point comment on the procedure and the efficacy of the method. It is essential to select suitable indexes that will ensure a comprehensive analysis, and that may be thought of as diagnostic features. It was decided in this test to use a set of 17 indexes covering three groups of features (as shown in Fig. 5), in order to determine the structure of the population, the presence of certain types of public institutions, facilities for public use, etc.[5]

The correlation coefficients in the sub-matrixes that determine syndroms, and combinations between the syndromes, confirm the hypothesis of the high conformity of features during the period preceding investment. A similar analysis performed on sample data collected during a later period, also confirmed the thesis that the correlation coefficients diminish in strength in the course of the changes in a settlement network.

An examination of the correlation within the syndromes of the features answers the question whether the sum total of correlations within a given syndrome is sufficiently high, and whether it is possible to substitute one feature for several strongly correlated ones.

The correlations between the features have been illustrated by the circular diagram mentioned earlier; this shows two types of relation: 0.500–0.700 (thin line) and correlation coefficients higher than 0.700 — showing stronger relations. These form characteristic sets (Fig. 5).

High correlation coefficients are the result of an adjustment of demographic (social, etc.) features and of the spatial structure (morphology) of settlements to their functions, after having been influenced by these functions for a longer time.

Stability, that bears witness to the system having assumed its structural shape, is a feature of the period preceding the commencement of investment. For a farming region, the most suitable network during the period preceding industrialization is the traditional system based mainly on two functional types of settlements: farming settlements and centres of various ranks (service centres). Here, the dichotomous functional system of settlements leads to the predominance of a single type of relation, service relations. This may be reflected in the areal arrangement which because of its regularity would remind us of the central place model.

(3) Investment is known to upset the state of equilibrium of a settlement system. Visible proof of this is the change in the syndromes of features that characterize the elements of a settlement network. Changes in the individual elements as well as those in the entire settlement network, have a temporal and spatial sequence. Their rate and course depend on such factors as: the initial functional and areal structure, the disposition of natural resources (when they are the foundation of the development of new projects and new exogenous functions), the adopted concept of the functional and areal structure of a region, and so on.

[5] No complete records are given here because of the lack of space (concerning the matrixes of coefficients, sub-matrixes of syndromes, etc.). Instead, the enclosed diagram (Fig. 5) is given; this is the necessary minimum, as it contains a complete set of features, and two types of the strongest ties.

The most sensitive indicators of change are functions and certain features of the population structure. Changes in the morphology of individual settlements and in the spatial structure of an entire settlement network are notably slow. One thing that deserves attention, are those changes that consist both in the emergence of new primary exogenic functions, and in the adaptation of the functions of individual settlements to these primary ones. Functional aspects influence a number of changes in the structure of the population, for example: (a) the change of the total population in individual settlements (mainly due to increased migration); (b) changes in a number of demographic features of the population, e.g., age, sex, family status, etc.; (c) changes within the social and professional structure, due to new job openings mostly in the industry.

All the above phenomena are a result of changes within societies which have until now been stabilized and homogenous and also due to immigration. The new arrivals are usually different from the older inhabitants. The predominance of young, unmarried men among the new arrivals (particularly during the first stage of investment construction) leads to the emergence of specific features in the population. In the regions undergoing industrialization in Western Poland, new investment has started new waves of immigration, mainly to the centres of the newly emerging region (industrial centres or dwelling settlements).

An essential part of total migration is daily commuting (Czarnecka 1966, Musiał 1971). This varies according to region and to the stage of development of a given region. Commuting also plays a major part in forming integrated settlement groups (complexes).

(5) A result of completing or interrupting investment activity is a tendency for the settlement complex to reach a state of equilibrium as close as possible to the time when investment stimuli cease to be present. The new state of equilibrium is different from that of the initial period, because of the changes that have meanwhile occurred.

(6) It can be anticipated that the final effect will be the emergence of a strongly integrated settlement complex composed of settlements having definite roles within the complex, and similarly having definite relations with the exogenous functions of the region. These relations are of organizational and productional ties, the flow of goods, commuting, services, etc.

EMERGENCE OF A SETTLEMENT COMPLEX AS A FORM OF INTEGRATION OF SETTLEMENTS

The hypothesis presented above, concerning the emergence of a settlement complex, requires a more comprehensive treatment. A settlement complex is understood to be a grouping of rural and urban settlements, which realize, as an integral whole, certain exogenous functions. Apart from the exogenous functions (represented by industry) which act as primary ones for the entire group of settlements, there are also endogenous functions (e.g. services) which meet the requirements of the inhabitants of settlements within the complex. The individual settlements within the complex are strongly linked to each other, sometimes because of their topography (Zagożdżon 1968).

The presence of an individual settlement within this integrated system, as an element of a complex, is indispensable for the correct functioning of the whole.

A fully developed settlement complex should show the following features:

(1) a definite exogenous function, responsible for the formation of the complex, and for its permanent integration;

(2) specialization of the endogenous functions of settlements within the complex;

(3) ties linking the settlements, resulting both from the exogenous functions and from meeting the numerous requirements of the inhabitants of the settlements and thus from endogenic functions.

The interrelation of settlements within a complex is thus bilateral: it is a result of both exogenous functions (which are the basis of its existence — part of the functions of settlements; or of the functions of a part of settlements closely related with the above), and of the necessity of meeting the requirements of the inhibitants of settlements in the complex.

If the exogenous functions are performed by industry the basic types of relations may be a flow of cargoes resulting from the manufacturing cycle and from the organization of manufacturing works.

The structure of an emerging complex which is the nucleus of a region under industrialization, is the result of many factors. A major part may be played by certain elements of the geographical environment, such as water or natural resources.

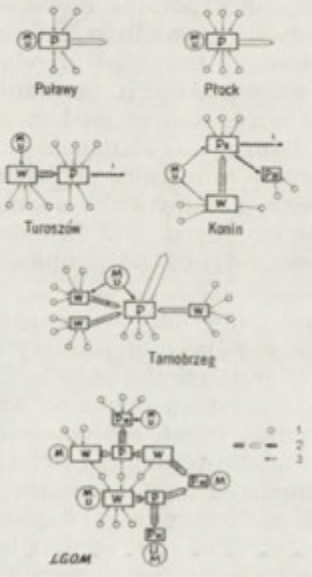

Fig. 6. Interrelations in industrializing regions
Functions: M — residential, U — services, P — production, W — extraction
Type of production: P_H — metallurgical, P_E — electric power supply, 1 — complementary residential functions, 2 — commodities, 3 — commuting
L.G.O.M. = Legnica-Głogów Copper Mining District

If the complex (and the whole region under industrialization) is founded upon mining natural resources, the location of deposits, operational conditions, access to the raw materials, and related factors assume the greatest importance.[6]

[6] One can mention here at least four types of raw material deposits (according to Haggett): a) resources equally accessible over a considerable area, i.e., uniform

The shape taken by the complex within the area is also influenced by the network lay-outs already established; these are very important for the balance of expenditure of every project, and frequently determine location decisions.

Network systems, and the other features previously established, may also influence the complexity of the functional and morphological structure of the complex, which usually becomes more complicated as the industrial region develops.[7] Poland's present industrializing regions show important differences. Some of these regions are illustrated in the diagram of Figure 6. It shows the structure and the most important elements of functions.

A simplified structure of the individual regions is made up of the main centres in which the exogenous functions are concentrated (such as coal or copper as a raw material and their subsequent processing) and the functional elements which are the most important types and trends of relations, and result from the primary functions (flows of raw materials, goods, people, etc.). The multitude of functions leads to the emergence of mono- and polyfunctional complexes, while the distribution of functions causes the emergence of mono- and polycentric complexes and of their possible combination.

Important differences between complexes in different regions under industrialization can depend on the type of production and on the type of organization. The diagrams of the complexes apply mainly to the elements of primary functions (Fig. 6). A complex incorporates, however, a considerable number of settlements which serve as dwelling satellites, linked with the centre (or centres) by commuting to work. Although this type of relation is not always the most important, much has been written about it. Commuting to work has been shown to be a good measure of the integration of settlements which are known to react to the successive stages of change; this statistical data is readily available. If we consider commuting to work as a measure of the integration of settlements, at least two comparative indexes are involved: an index of the number of commuters in the total of those employed; and an index of the proportion of each settlement in the employment total of the complex (Czarnecka 1966; Zagożdżon 1968).

The above indexes permit not only a comparison of different examples (which vary considerably in size, type of primary functions, and in structure), but moreover can be used to indicate the pace and nature of change of a complex. Research confirms a typical phenomenon accompanying the emergence of a complex: this is a pulsation which consists in the change of its extent and is due to the varying share of the settlement (which has been the main centre) in the total labour force employed in the complex. We are concerned, here, of course, with relative values, as the numerical increase in the employment figure and a major share of the centre may be seen as before. The varying share of the centre in the total employment figure within a complex may be accompanied by an extension or reduction of the extent of commuting (pulsation) that surround individual settlements, during the different stages of development.

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distribution of resources; b) spot concentration (point resources); c) occurrence of raw materials within a specific zone (zonal resources); d) band or linear distribution (linear-resources).

[7] Hence, complexes which existed during the earlier phases of development of a region, usually had a less complicated structure; they had formed local settlement complexes (with a simple structure), and were transformed during later periods into composite complexes and multi-composite complexes. The principle of complexity is explained by the tripartite graphic model, designed by the author (Zagożdżon 1968), and in pattern takes after the system of local units proposed by K. Dziewoński in his morphological analysis of towns (Dziewoński 1962).

The final effect of all this may lead to the specialization of certain settlements due to the development of their satellite functions. If this happens, the zone (distance) of commuting may remain unchanged, or may even be reduced (a reduction of commuting routes as the complex becomes more stable).

The problem of the shaping of a settlement complex from the initial stage characterized by the traditional model of a service agency network and of rural settlements, to the consolidation of a polycentric settlement during the final stage, has been discussed in a separate work (Zagozdzon 1972, see particularly Fig. 8).

The structural model of the Legnica–Glogów Copper Mining District, as an example of a polycentric system (or a polynuclear one; see Fig. 6), is dominated by a linear arrangement of natural resources (copper ore deposits), as well as by a strongly dispersed distribution of basic production projects engaged in the output and processing of copper ore, etc. A logical consequence of the dispersal or deconcentration of industrial centres should be a certain deconcentration of the dwelling pattern. This is reflected in the concept of a regional plan to create conditions for the development of an entire network, for example through a great increase in the residential functions of several settlements with about 40,000 or more inhabitants. Although this model may appear to be the optimum development of the settlement network, its implementation in practice meets certain difficulties. These are due to the trend towards concentrating the residential potential in the town of Lubin. Apart from their industrial and dwelling functions such dwelling districts are centres of decision making and management, and at the same time curtailing the increase in the other centres. These trends are not a result of actual conditions, but result from non-economic circumstances which can be traced to the local patriotism of the district authorities who are trying to build up their town to 100,000 inhabitants.

STAGES OF URBANIZATION

Research on the rate of development of settlement systems needs to estimate the social and economic "age" of a system. This permits to determine the degree of process of a given system, and to compare it with other systems. Although it is very important to estimate the "age" of a system, this is naturally not easy. Finding suitable indexes and developing proper scales of reference requires still more research, which has yet to be started for this purpose. The present state of this research does not allow us to establish a scale; it does permit us, however, to describe the level of development of a region as low, medium or high. This may act as a foundation on which to build a verbal scheme, and help us to determine the stage of development of a settlement system. This process is defined by the term "urbanization", which is to be understood as the penetration of ideas and practical models from the municipal centres to their surrounding zones, as well as the changes of the population structure, functions and morphology of the settlements.

In examining a system, one should, I think, distinguish between two situations.

The first one may be called the "organic urbanization", and is characterized by the penetration of ideas and practical models from the town in general, the latter to be considered as a type of cultural-social unit.

The second situation may be called the "controlled urbanization", and is characterized by the penetration of the above models from a specific industrial centre. This process is programmed by the appropriate planning and decision making centres, in order to mould, the area's complex structure.

In fact, both these situations may occur at the same time, and it is not easy to distinguish them when studying a region of intense industrialization. Changes occurring on a nation-wide scale caused by various large-scale factors can often be traced to the impact of a certain project, or a certain urban-industrial centre. It is not always straightforward, in spite of the general belief, to distinguish between those two situations. It is often important in practice to do so, however, e.g., in studying the social expenses involved in a certain project. It is hoped the stages of urbanization proposed here, may prove helpful in drawing this distinction.

One can distinguish four main stages in the changes in a settlement system undergoing industrialization (Jałowiecki, Zagożdżon, 1970).

Stage I. A low level of industrialization, with industry of local importance only. A limited area of social contact, weak links with the centre (services, labour). Most of the population engaged in farming, low degree of professional skill, low standard of agricultural skill, few people with two jobs. Low level of consumption accompanied by an equally low level of cultural activities. Furthermore, little appreciation for the necessity of education. The above social and occupational features correspond to the predominance of farmstead buildings in the settlements, their groupings, in most cases, forming simple morphological systems. The functional structure of such a network for most of the settlements is agricultural, and a "traditional" system of service centres (which is sometimes similar to the Christaller's model of central settlements). A structure of this kind may be as typical of "organic initial urbanization".

Stage II. An average level of industrialization, with industry of not just a local character. A considerably larger area of social contact; causal links with many centres (labour, services). A very wide, though not necessary stable, sphere of influence of the centres; this is particularly evident with commuting to work. Beginnings of functional specialization of centres, and of some integration of groups of settlements in the form of wholes bearing a local character. Functional differentiation of rural settlements in the majority of cases, but without new units being formed; its beginnings can be traced to the emergence of a new primary function, which is a complex forming one. This leads to an adaptation by the individual settlement of the new primary functions of an emerging complex. The population is mainly employed in farming, but there are traces of employment of skilled labour in agriculture and an increase in the number of people with two jobs. The consumption requirements are increasing, although low participation in cultural activities continues as before. There is more interest in the education of children.

Stage III. A high standard of industrialization, with industry of not just a local character. A large area of social contact, strong ties with the emerging centre (employment, services). A diminishing proportion of the farming population, a progressive professional trend in employment. Increase in the population employed solely in non-agricultural occupations. A more definite emergence of a large-scale integrated settlement community, of an industrial-settlement complex type. This results not only from commuting to work (as in the previous stage) and to certain service relations, but also to manufacturing ties. This is the stage of advanced links, and of the separation of a group of settlements with the strongest ties. There is a specialization of industrial works, and their resulting cooperation. There is a noticeable reduction in the size of the zones of influence of the centres, and an increase in the strength of links, both making the inter-settlement contacts more durable. This is the stage of changes in the morphology of the settlements, resulting from changes in their functions. These latter changes may be seen as the adaptation of the previous pattern, of the

settlements to their new role in the complex. It mainly concerns, however, the functional non-productive units, since the productional units involved in the new functions of the area emerged earlier. The development of non-agricultural settlement beyond town boundaries is frequently the cause of a spontaneous building activity, and leads to the emergence of new units based on new location principles (e.g. in the public transport system). In previous agricultural settlements, there is a change in the type of building, from farmsteads to single-family houses. It is here that a distinct increase in consume needs is manifested, for instance, in domestic needs. There is some increase in cultural needs. There is an increase in number of children in secondary education mainly in technical and "vocational" schools (the type of schools depending on the character of the region), and partially in grammar schools.

Stage IV. A high level of industrialization, with industry of not just a local character. A large area of social contact. Certain strong tries with the centres (e.g. employment, services, entertainment). A neglible proportion of agricultural population; the percentage of those with two jobs greatly decreases, and the level of professionalism in employment increases; on the other hand there is a large increase in the population employed solely in non agricultural occupations. The duration of functional relations leads to changes not only within individual settlements, but also in the areal organization of the entire complex. A functional stabilization of the structure can be seen. The emergence of ribbon settlement structures and the beginnings of structures of amalgamations that occupy considerable areas may lead to the obliteration of differences between rural and urban settlement forms. Strongly developed consumption requirements can be seen, particularly in domestic consumption. The considerable development of cultural needs is partially met by commuting to municipal centres. Education of children in high schools is more widespread than before.

The stages in the development of the settlement complex and network in a region under industrialization undoubtedly influence the mechanisms of the urbanization processes.

This is shown in the Table 1 for two periods: the initial period, showing the pre-industrial state, and the final period. The table shows the various research fields, and the research methods and techniques that have been used.

The contents of this table are related to the diagram of the organization of research presented above (Fig. 2).

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The problems of the changes of a settlement network in a region under industrialization presented here, do obviously not cover the whole of this complex subject; this would be beyond the capabilities of a single author anyway. However, I think this survey has pointed to the importance of the above problems, which are particularly vital in socialist industrialization.

A number of matters in this subject need further research and methodical solutions. What is needed is the construction of formalized models to more accurately describe the phenomena involved. Further research, based on present methods and on others is required on regions providing more differentiated examples.

Intense exploratory research necessitates many improvements, namely, in the organization of research, a better use of sources, including statistical, cartographic and other data, that enable a rapid "photography" of a region at a given stage.

TABLE 1. Settlement network changes in a region undergoing industrialization (Hypotheses of change and research techniques)

Scope and types of changes	Initial state	Final state	Some methods and techniques of analysis
I. FUNCTIONS Transformation of local systems into a settlement complex			
(a) exogenous functions, changes in types and size of functions	Limited scope and size of functions	Regional or nation-wide functions	Gravity models
(b) changes in functions of individual settlements	Homogeneous functional structures	Heterogeneous functions, functional disintegration of settlements, integration of functions within a settlement complex	Taxonomic methods
(c) changes in size and rank of settlement units	Stabilized rank-size distribution of settlement units	Rank system based on a mono- or polycentric complex	Rank-size analysis Nearest neighbour analysis
(d) relations — changes in types and frequency of links	Interpersonal relations, institutional-personal relations	Relations: institution-to-client institutional productional organizational	Graph analyses Flow analyses

II. POPULATION			
(1) Disintegration of population structure	Stabilized demographic structure, no immigration, population stabilization or emigration, homogeneous or slightly varied occupational structures	Heterogeneous structures of demographic indexes, population composition, etc.	Statistical analysis of demographic features Innovation diffusion models Migration models Colonization models Chance competition models
(2) Differentiation and increase in the needs of the population	Narrow range of needs, self-sufficiency of rural households	Wide range of needs; specialization, labour time and role division within a family	
III. SPATIAL PATTERN			
(1) Reorganization of spatial patterns (a) changes in distribution of elements in the network	"Rural" settlement network, production-farming complexes, regular distribution, "point model"	Urbanized network: settlement complexes, other integration forms; linear, ribbon, horizontal models	Analysis of concentration and spatial amalgamation Genetic and morpholological classifications
(b) changes in morphological structure	Overdomination of simple structures. Sporadic occurrence of complex structures (cities)	Increasing morphological complexity of elements of a system	Graph models Flow models (e.g. evacuation index)
(2) Changes in transportation and communication network etc. Reorganization by adaptation to new regional functions	simple network structure: local, frequently "detached" networks, poorly developed nodes	complex network structure (cycles and cycle systems), network complexes involved in production functions, transit, etc. High complexity of nodes	Metrological analyses

One method which is not satisfactorily used is air photography, which is proving invaluable for researches. The success and the results of research largely depend on organizing the information system into a data bank. Such an advanced system of information collecting and evaluation would improve exploratory and methodological research, and would further the construction of a model of changes in a region, so essential for understanding the facts, and so necessary for forecasting and planning.

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PROBLEMS IN THE PLANNING AND CONTROLLING THE GROWTH OF LARGE TOWNS (WITH EXAMPLES FROM THE BYELORUSSIAN SSR)

Vitalii F. Medvedev and Spartak A. Polskii

The size of the urban population and the role of large towns are increasing under an accelerating tempo in the scientific-technical revolution and an increase in both the movements and the needs of the population. At the same time, urban systems and methods of controlling their growth, and the planning and regulating of their interaction with the surrounding areas, are becoming more complex. The planned socialism system requires a scientific control of all these social economic processes. In order to select the best solution from the many available, one must have a thorough analysis of the working of objective economic laws. As is well known, the problem of town development encompasses many questions, from those of assigning people to particular urban settlements to those decisions of national importance, concerning the development of the settlement system as a whole. The planning and regulating of the growth of large towns is very important in resolving the settlement problem.

The problems of controlling the growth of large towns are accompanied by the appearance and growth of many difficulties, which become even more difficult to solve as the density of the population increases and the industrial enterprises within the city multiply. The difficulties of communication, transport, housing, sanitation, and supply, and social, political, military and other problems become more pronounced.[1] Industry cannot be concentrated in the large towns *ad infinitum* without going against the needs of the complex development of the national economy. When the building of the communist society produces an abundance of material, cultural and spiritual goods, the large towns will lose their temporary privileges and their sanitary, social and economic shortcomings will then be all the more evident. Therefore the removal of the excessive concentration of population in large towns is one of the more important prerequisites of the development of the communist forms of settlement.[2] Regulating the growth of large towns in the Soviet Union through a series of (social) measures, shows that it is possible to plan the soviet economy by scientifically controlling socio-economic development.

In Byelorussian SSR regulating the growth of large towns, and perfecting the settlement system with the aim of achieving greater functional precision,

[1] E. Rosset, *Perspektywy demograficzne Polski* (Demographic perspectives of Poland), Warszawa 1962, pp. 195–196.

[2] *Osnovy Sovetskovo gradostroitel'stva* (Principles of Soviet Town Planning), Moskva 1966, vol. 1.

is based on a knowledge of the socio-economic processes in the development and distribution of the forces of production and in the organization of society. The greater the intensification of the national economy the more necessary is a long-term view of the further development of settlement, and also a radical rebuilding of the urban system. The present system of urban settlement in Byelorussia does not satisfy the present needs, still less those of the future.

According to the 1970 census, 56.7% of the urban population live in the nine Byelorussian towns with over 100,000 inhabitants; the rest live in 195 small and medium sized urban settlements. Forecasts made by the Scientific-Research Institute of Economic and Mathematical-Economic Methods of Planning (NIIEMP) of the Byelorussian State Planning Committee (GOSPLAN), show that there will be a considerable increase in the urban population of the republic. The question is how to distribute this expected increase. In solving this problem an important part must be:

(1) defining the scale, direction and rate of the development and distribution of the forces of production, and from this, defining the important aims and long-term proportions of urban and rural population;

(2) assessing the possibilities of the development of each urban settlement (taking into account its surrounding rural settlements).

The development of existing large towns, as is well known, is determined by the location of new ones and by the development and expansion of building and industrial enterprises, transport, higher and specialized middle educational institutions, scientific, medical and social institutions and other organizations in these towns. The most important city-forming factor in the majority of large towns is industry.

The development and distribution of the productive forces in the post-war period in Byelorussia concentrated on the rebuilding of destroyed factories on a new technical basis, and the building of new enterprises in these restored towns. Therefore one of the characteristic features of the distribution of industrial production in Byelorussia in the first five-year plans (1946–1960) was its high concentration in the large towns. The directing of much of the capital investment to these towns was essential for speeding up the reconstruction and normal functioning of the destroyed Byelorussian economy.[3] In those years, a more intensive development of large towns and their transformation into bases of industrialization of the whole republic was both necessary at this stage of development.

In the early 1960's there were essential improvements in the distribution of productive forces in Byelorussia; industry began to develop most rapidly in medium and small towns. Thus in the period 1960–1965, while the number of those employed in industry in Minsk increased by 41.3%, and in the industry of large towns by 38.7%, in towns with 50–100 thousand inhabitants it increased by 75.1% and in those with 20–50 thousand, by over 200%.[4] Already 70% of large and medium sized enterprises planned for 1966–1970 in Byelorussia have been located in towns with less than 100 thousand inhabitants. None the less, the share of large towns in the industrial potential of Byelorussia remains very large. In 1968 over half of both the industrial production personnel and

[3] V. F. Medvedev, S. A. Polskii, *Planirovaniye i regulirovaniye rosta gorodov — Byeloruskaya SSR* (Planning and controlling urban growth — Byelorussian SSR), Minsk 1969, p. 9.

[4] A. V. Bogdanovich, Osobennosti razvitiya promyshlennosti v gorodakh razlichnykh kategorii — na primerye Byelorusskoi SSR (On some features of industrial development in cities of various size categories on the example of the Byelorussian SSR), in: *Optimal'noye planirovaniye v otraslyakh narodnovo khozyaistva*, part 1, Minsk 1968, p. 29.

value of industrial production belonged to Minsk and six large towns (Gomel, Vitebsk, Mogilev, Bobruisk, Grodno and Brest). An important part of the industrial production and population of the *oblast* is concentrated in each of these towns. The methods of limiting new industrial construction in the large Byelorussian towns over recent years can be seen both as the first stage in the appropriate work and as a transition to more intensive development of middle and small towns. It is recommended that in the near future new industrial construction be built chiefly in 37 medium and small Byelorussian towns. About 80% of the capital invested in industrial construction is being directed to towns with up to 100 thousand population.

In defining the socio-economic perspectives in the development of urban settlements, an important contribution is the forecast worked out by NIIEMP of the growth and structure of the population by the year 2000 and of the scheme of development and distribution of productive forces in the period up to 1980. Planning and controlling the growth of large towns, and carrying out projects, such as general town plans, whose main task is to correctly define the scale of development, are especially important. Currently, most towns in Byelorussia possess approved general plans for their development; these are periodically revised. An important step in the scientific forecasting of the long-term development of urban and rural Byelorussian settlements is the forecast "The main directives of planning and shaping urban and rural settlements in Byelorussian SSR up to the year 2000" and also the general plan of the development of Minsk to the year 2000. The former is being worked out by the Minsk branch of the Central Scientific Research Institute of Urban Planning (CNIIP) with the help of NIIEMP and the Byelgiproselstroy Institute, and the latter by Minskprojekt.

Similar long-term forecasts do not aim at accurately defining the configuration of settlement networks and the parameters of the development of individual settlement units. Their task is to evaluate general trends in the economic development of a given region or town, and also to evaluate those problems which may arise and make it necessary to bring in certain changes in economic, town construction and social-demographic policies. In other words they do not pretend to be comprehensive quantitative indicators, but they do allow us to define the direction of change arising from particular factors.

In Byelorussian SSR thanks to a fairly rapid pace of urbanization brought about by the development of industry and the mass exit from villages and small settlements of an urban type, the problem of regulating the growth of Minsk, Gomel, Vitebsk and Mogilev became important on a national economic scale. The problems of the growth of Minsk, connected with the development of a large town, appeared after the Great Patriotic War 1941–1945. The rebuilding of Minsk, which had been completely destroyed during the occupation, the growth of its industrial production, and the social organization of life in the post-war period proceeded at an unusually quick pace and was accompanied by a rapid growth in the population (Table 1). The table shows that Moscow and Leningrad, the largest cities of the Soviet Union, in the intercensus period had a relatively low rate of population increase. In the other group of "millionaire-cities" (Kiev, Tashkent, Kharkov, Gorki, Novosibirsk, Kuybyshev, Sverdlovsk) the average annual rate of population increase was higher, from 2% (Gorki) to 3.75% (Tashkent). The table also shows that of the 24 towns with more than 750,000 inhabitants, Minsk had the highest rate of population increase for the period 1959–1969. Its population increased by 398,000 during this period, and its average annual increase was 5.4%, i.e., much higher than in all the other towns in the table.

TABLE 1. The growth of population in Soviet towns with more than 750,000 inhabitants

Towns	1959 (census) (in 000's)	1970 (census) (in 000's)	1959–1970 Absolute increase (in 000's)	1959–1970 Annual average increase (in %)
Moscow	5046[a]	6942	933	1.3
	6009[b]			
Leningrad	2900[a]	3513	613	1.75
Kiev	1104	1632	528	3.6
Tashkent	912	1385	473	3.75
Kharkov	934	1223	289	2.5
Gorki	942	1170	228	2.0
Novosibirsk	846	1161	275	2.5
Kuibyshev	806	1047	241	2.4
Sverdlovsk	779	1026	247	2.55
Minsk	509	907	398	5.4
Odessa	667	892	225	2.7
Tbilisi	695	889	194	2.25
Donetsk	699	879	180	2.1
Chelyabinsk	689	874	185	2.2
Kazan	647	869	222	2.7
Dnepropetrovsk	660	863	203	2.45
Perm	629	850	221	2.8
Baku	643	847	204	2.55
Omsk	581	821	240	3.2
Volgograd	592	818	226	3.0
Rostov-on-Don	600	789	189	2.5
Ufa	547	773	226	3.2
Yerevan	509	767	258	3.8
Saratov	582	758	177	2.45

Source: 1959 — *Itogi Vsesoyuznoi perepisi naseleniya* 1959 SSSR (summary volume), Moscow, Gosstatizdat 1962, p. 30
1970 — O predvaritel'nykh itogakh Vsesoyuznoi perepisi naseleniya, Moskva 1970, *Statistika* 1970, p. 11.

[a] for the city boundaries in 1959

[b] for the present city boundaries

Note: Moscow, Leningrad, Minsk and Baku — not including the urban settlements under the authority of the city council

To estimate the rate of growth of towns one can also use an index of the period of "doubling" (the number of years in which the population doubles assuming the existing rate of growth remains unchanged) (Table 2).

Over the 11-year intercensus period 1959–70 the increase in Minsk's population averaged 35–40,000 each year. From our calculations Minsk's "doubling" period is 13 years. If the existing rate of growth is sustained for Minsk, Sverdlovsk, Kuybyshev and Gorki, the population of Minsk will otvertake that of Sverdlovsk within 7–8 years, Kuybyshev within 8–9 and Gorki within 14–16 years.[5]

[5] O. K. Kudryavtsev, Izmeneniye v raspredelenii naselennykh mest SSSR po velichine za 1959–1964 (Changes in size distribution of settlements in the USRR 1959–1964), in: *Voprosy gradostroitel'stva*, IV Kiev 1965, pp. 32–33.

Cities with over a million inhabitants have particularly complex problems of development; there are 9 of these cities in the Soviet Union. Minsk, the capital of Byelorussia will probably be the next town to join this group. Since this town has the highest rate of population growth, the economic and social problems in controlling its growth are especially marked. Its former inhabitants began to return to the town from the first days of its liberation from the fascist occupation. In 1945 the automatic population increase amounted to 50,000 and was sufficiently high in the first post-war five-year period.

TABLE 2. The number of years in which the population will double (with a constant rate of growth)

Average annual population increase (%)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0
Period of "doubling" (in years)	72	47	35	28	23	20	18	16	14	12	10	9	8	7

After the drop in the automatic growth which occurred in the late 1940's and early 1950's (mainly because of housing difficulties) from the mid-fifties the rapid growth in industrial construction in the city led to a much greater demand for labour.

Each post-war year in Minsk had a significant absolute population increase thanks to the favourable balance of migration, which grew from 7400 in 1950 to 34,300 in 1969 (in 1969 this was 3 times higher than the natural increase). At the same time there was a significant growth in the sub-urban agricultural region, the only one of the 22 administrative *raions* of the Minsk *oblast* where the population increased (by 30%) for 1959–1969. The population of 4 *raions* remained the same as in 1959, and in 17 it decreased. This shows that the suburban areas, (in the case of Minsk an administrative *raion*), are zones of increased territorial mobility. Inhabitants from other *oblasts* in Byelorussia and other republics of the Soviet Union come to the settlements of the Minsk *raion*. These settlements are a type of "transit station" in the process of moving to Minsk.

In controlling the growth of towns and especially in solving problems of the reconstruction and rebuilding of industrial enterprises important in terms of city-forming functions, an important means such as the planned allocation of capital investment has not yet been sufficiently employed. From 1946 to 1969 tens of large enterprises, hundreds of factory workshops and other buildings were built in Minsk. Also, tens of factories, destroyed during the war, were rebuilt and enlarged. The accelerating development of those industries requiring a lot of labour but not much power or raw materials was a characteristic factor in the latest ten-year period of Minsk's growth. Regarding the rapid pace in the growth of Minsk's industrial production, it must be said that this growth is now in conflict with the interests of the towns's development. The point has come when all new enterprises, other than those directly serving the population, have been banned from the city. However, despite this ban new industries are still being built (usually under the condition of extending and reconstructing existing enterprises). Meanwhile it is well known that the extension of industrial enterprises by building new sections and rebuilding existing ones, is done at the cost of the free plots of land within the

boundaries of an enterprise; this usually leads to an increase in the number (on average 30 to 50%) of workers.[6] In Minsk, from 1959–1965 alone there was an increase of 40%; 90% of this increase came from the development of existing enterprises. The number of manual and white-collar workers in over the last 8–9 years has increased by more than 100,000 simply through the reconstruction and extension of enterprises. The basic difficulty in resolving the question of limiting the further growth of large towns lies in the nature of extension and reconstruction of existing enterprises. This extension and reconstruction ought to be carried out without a significant increase in the number of jobs, which would fully agree with the tasks of intensifying industrial production put forward in the Directives of the 24th Congress of the Communist Party of the Soviet Union.

TABLE 3. Changes in the population of Byelorussian towns with more than 100,000 inhabitants

Town	1959 (census) (in 000's)	1970 (census) (in 000's)	Absolute increase (000's)	Annual average increase (%)
Gomel	168.3	272.0	103.7	4.45
Vitebsk	148.3	231.0	82.7	4.1
Mogilev	121.7	202.0	80.3	4.7
Bobruisk	97.6	138.0	40.4	3.2
Grodno	72.9	132.0	59.1	5.55
Brest	73.6	122.0	48.4	4.7
Baranoviche	58.1	102.0	43.9	5.25
Orsha	64.4	101.0	36.6	4.2

Source: 1959 — *Itogi Vsesoyuznoi perepisi naseleniya 1959 Byelorusskaya SSR*, Moskva, Gostatizdat, 1963 p. 13

1970 — O predvaritel'nykh itogakh Vsesoyuznoi perepisi naseleniya, Moskva 1970, *Statistika 1970*, p. 13–15.

At present the towns Gomel, Vitebsk and Mogilev (Table 3) are at a similar stage of industrial development as Minsk was 20 years ago. Therefore the problem of controlling the growth of these towns is even more important. The terminating of new industrial construction in Minsk and its curtailing in Gomel, Vitebsk and Mogilev does not, of course, mean that industrial production should not keep developing. The growth of future industrial production in these towns must not be through increasing the number of industrial-production personnel, but through a fuller use of existing productive forces, consistent application of complex automation and mechanization of industrial production, in order to replace out-of-date equipment and through this increase the labour productivity. The curtailing of new industrial construction in these towns does not, of course, mean the curtailing of their non-industrial functions. In the future the functional structure of Minsk, Gomel, Vitebsk and Mogilev will reflect above all their growing importance as cultural-political centres and centres of science and services, and not simply as industrial centres. Solving the problem of the further development of Minsk is intimately connected with the development of the economy of Byelorussia as a whole, and above all with the development of the other urban settlements of the Minsk Industrial Region. The formation and development of town satellites around Minsk makes it

[6] *Osnovy Sovetskovo gradostroitel'stva* (Principles of soviet town planning), Moskva 1967, vol. 2, p. 78.

easier to control the town's development, permits the expansion of the Minsk production complex at the same time easing the load of that part of production which requires a lot of land and is harmful to the environment. This also makes it possible to reduce the outlay on improving the urban infrastructure. From the elaboration of the plans "A scheme of regional planning for the Minsk Industrial Region (within a radius of 80 km)" and "A scheme of planning for the sub-urban zone of Minsk" proposals have been put forward for the transfer of a series of industrial enterprises to Zhodino, Borisov and other towns of this region; their location was previously planned for Minsk. One of the first examples of this decision was the setting up of the Byelorussian Automobile Factory in Zhodino, which is 50 km from Minsk. At first this was set up as a branch of the Minsk automobile factory but it later became independent.[7]

An important step in regulating the growth of large towns is the location of a large number of branches of Minsk enterprises in other Byelorussian towns. For example a branch of a ball bearing factory is being set up in Molodechno, of a machine-tool factory in Marina Gorek, of an automobile factory in Osipoviche, of an automatic line factory in Baranoviche, and several others. 20,000 people will be employed in the Minsk branches located in small and medium towns.

As well as banning new industrial enterprises as a means of limiting Minsk's growth it is necessary to get the agreement of the planning organs of the Byelorussian republic and the Minsk Executive Committee on:

(1) the opening of bank accounts for newly located enterprises in Minsk in the republican branches of the USSR State and Investment Banks;

(2) financing the extension and reconstruction of important enterprises in the town.

The most effective way of solving the rational distribution of industry is the development of a prescribed number of second order industrial centres in order to both supplement and counteract the large towns. The preferential development of towns with between 150,000 and 200,000 inhabitants will successfully solve the question of limiting the growth of Minsk; at the same time it will prevent an inefficient dispersion of industry throughout many small towns.

Planning the development of the settlement network in Byelorussian SSR assumes that the future network will provide a standard level of favourable conditions for work, domestic life and recreation throughout the republic. Thus the development of individual towns must be carried out with the requirements of the whole settlement system in mind, since each town is an integral part of this system. Current urban studies show that the economic and other links between towns are multiplying and becoming more complex. Controlling the growth of an individual town, as one of a group of settlements, must be linked with the control over neighbouring settlements which are economically and technically linked with each other.[8] These requirements may be realized only by creating a fairly uniform hierarchical network of central towns. These towns will influence a prescribed area and will be accessible to one day trips for people in this area.

[7] N. A. Solofnenko, Goroda-sputniki i noviye samostoyatel'niye goroda, kak deistvenniye faktory ogranicheniya rosta krupneishikh gorodov (Satellite-towns and new individual towns as factors limiting the growth of large cities), in: *Problemy rasseleniya*, Kiev 1966, p. 9.

[8] N. V. Baranov, Problemy perspektivnovo razvitiya sovetskovo gradostroitel'stva (Problems of long-term development of soviet town planning), *Arkhitektura SSSR*, No. 4, 1970.

In perfecting the settlement system of Byelorussia its further development ought to proceed according to a series of guidelines for solving the problem of the growth of large, medium and small towns. The location of new industrial enterprises in the near future will strengthen the economic base of a prescribed group of towns, forming an important intra-*oblast* economic-organizational centre. At the same time the benefits of the concentration of production will aid the dispersion of the economic and cultural influence of similar, sufficiently developed and multifunctional towns, throughout the whole republic.

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Gosplan of the Byelorussian Socialist Soviet Republic.

GEOGRAPHIA POLONICA 27, 1973

THE EFFECT OF INDUSTRY ON THE DEVELOPMENT OF TOWNS. SELECTED PROBLEMS: THE CASE OF THE CITY OF CRACOW

Bronisław Kortus

The problem of the effects of industrial activity on urban development can be approached in two ways: (A) the distribution of industry, that is, the effect industry has on the functional structure, the size and significance of a particular town; in other words the city-forming function of industry. (B) The location of industry, or, the effect industry has on the spatial structure of a town.

(A) INDUSTRY AS A CITY-FORMING FACTOR

It is well known that the functions of towns change over time. The major functions of the pre-capitalist towns were political, defensive, commercial and cultural, whereas the production functions (such as handicrafts or mining) were as a rule of secondary importance. Soon after the appearance of manufacturing industrial concentration began, a process that took place mainly in the towns. Hence industrial production became the fundamental and most dynamic urban function from the beginning of the Industrial Revolution until the middle of this century. To use the apt phrase of Alexandersson (1967), "industry is responsible for urbanization".

Harris' (1943) functional classification of American cities for the year 1930 showed most of the total of 605 units included in his study industrial cities (i.e. with more than 30% of all economically active being employed in industry) — 258 units which makes up 44%. In 1959, a census disclosed that nearly all (317 out of 321) medium-sized and large towns in the Soviet Union (i.e. with more than 50,000 population) were industrial in character, that is, their share of industrial employment exceeded 30% (Khorev 1966). In Poland, the 1965 Industrial Census of the Polish Central Statistical Office located 84% of all industrial workplaces in towns, 6% in urban settlements, and only 10% in rural areas. This is also seen in most European countries, Switzerland being an exception with only 50% of the industrial employment in 1961 located in towns (though it must be noted that the Swiss regard as towns settlements with more than 10,000 population (Dufner 1964).

What were, or are, the causes of concentration of industry in towns? There are common location factors such as raw materials, transport networks, markets, manpower resources. Then there are additional, typically urban factors such as:

(1) The existing transports node in the town which can be easily and without considerable expense adapted to the needs of industries.

(2) The equally easy access to the existing electricity grids, water supply, gas and telecommunications networks.

(3) The possibility of establishing different kinds of production cooperation with other establishments.[1]

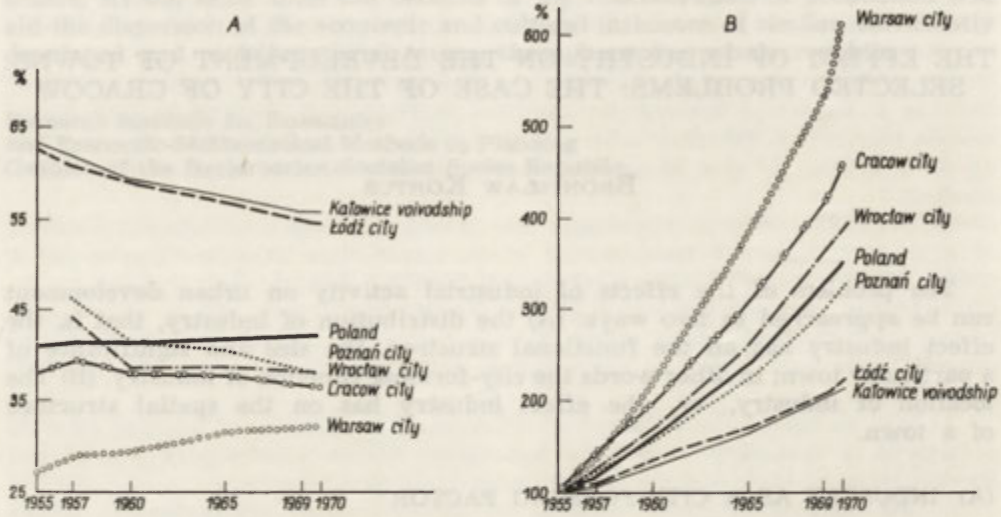

Fig. 1. Trends in industrialization in Poland

A — Share of industrial employment in the total economically active population 1955–1970, B — Index of the total industrial output (1950=100)

(4) The supply of qualified manpower and of its training facilities.

(5) The existence of a number of financial and administrative functions which facilitate the economic activities of industrial establishments.

(6) The existence of a scientific "infrastructure", i.e., higher schools, research institutes and laboratories, which promotes cooperation between industry and science, experimenting, etc. With the current scientific and technological revolution the significance of this factor is increasing.

(7) The existence of a specific local market (especially in the big cities) for luxury goods, fashionable clothes, intellectual needs, etc.

(8) The town usually provides employees (especially professionals) with a higher standard of living, cultural entertainment, and satisfaction of intellectual interests, etc.

As Krzyżanowski (1966) suggests, the town offers various advantages and often creates a specific atmosphere favourable to production and exchange.

In his study of the different types of "industrial complexes" Chardonnet (1953) distinguishes from among the industrial regions (or complexes) what he calls urban complexes. These differ from basic industrial regions by the special role played by the location factors mentioned above. Later, he devoted a separate study to these urban industrial complexes — *Metropoles économiques* (1959).

[1] The first three elements together constitute what is called "the factor of agglomeration" (mentioned already by A. Weber), which in effect leads to a concentration of industry.

From the standpoint of their origin and structure, contemporary industrial centres may be divided into the two following types (Kortus 1968):

(1) Centres that owe their origin to the local raw materials. These include mining-industrial cities in the coal-basins (e.g. Katowice, Chorzów, Wałbrzych, Essen, Donetsk, etc.), cities of petroleum extraction (Baku, Ploesti, a number of centres along the coast of the Mexican Bay), of iron ore extraction (Krivoy Rog, Magnitogorsk, Kiruna), and the less frequent case, centres that developed owing to water power (e.g. Zaporozh'ye on the Dnepr River). In these centres industry usually grew up before the town.[2] On the other hand when the town came first, its structure and function undervent a complete change under the impact of mining and industrial activity. This is what happened in Poland to Wałbrzych, Bytom, Gliwice and Będzin.

(2) Old historic towns, with few raw materials, and in which the advance of industrial development was of secondary importance, frequently adjusted to the local traditions and historical functions. Warsaw, Poznań, Wrocław, Nuremberg, Leipzig, Dresden, Milan, Torino, Lyon, Grenoble are some examples.

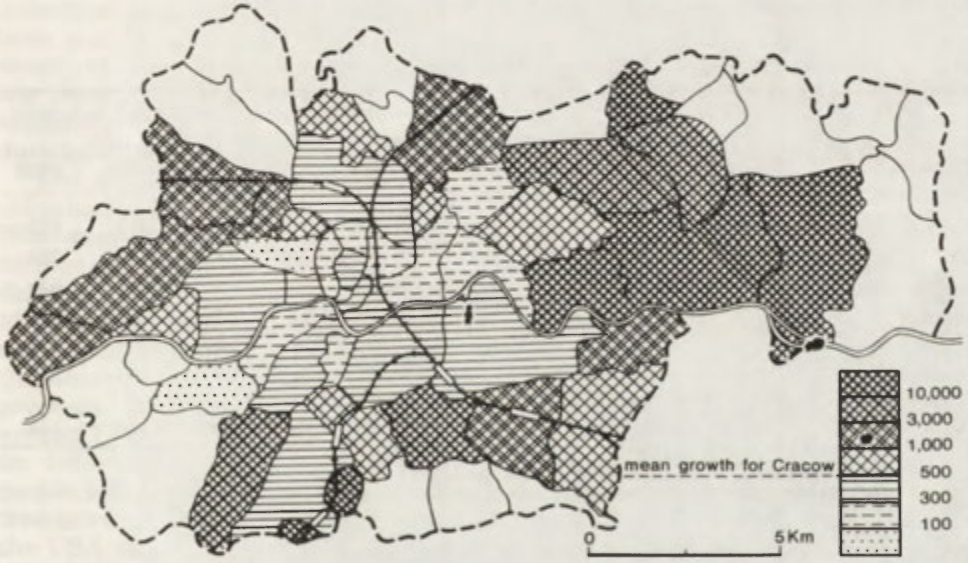

Fig. 2. Changes in the spatial structure of Cracow's industry in 1938–1965 (on the basis of the index of industrial employment, 1938 = 100)

Centres of the former type are marked by a predominance of raw materials and basic industries, and the latter mainly by manufacturing. Both the structure and the character of the second type, however, may be affected by the occurrence (or discovery) of nearby industrial raw materials, which then encourage the development of basic industries. The subject of the present study, the industry of Cracow, is a good example of this type of centre. The use of rock-salt as a raw material in Cracow's chemical industry and the short distance from the coal and metallurgical base of Upper Silesia were the two factors

[2] This group includes also a few industrial cities which developed on the basis of raw materials produced in other localities. In Poland such cities include for example Łódź and Stalowa Wola.

in the development of the basic chemical industries (production of soda and fertilizers), of the metal-demanding engineering and metal industries as well as of iron metallurgy and the production of building materials. Thus as an industrial centre, Cracow is in an intermediate position between the historical centres with a predominance of manufacturing, and the younger mining-industrial centres with a predominance of basic industries. (In 1970, the basic industries accounted for more than 60% of the total output of Cracow's industry). This intermediate character is mainly due to Cracow's situation on the periphery of the Upper Silesian Coal Basin (Kortus 1968).

Being a peripheral industrial centre during Poland's post-war intensive industrialization, Cracow took over a number of industrial investments that could not be located in the Upper-Silesian Industrial Region. These include the new ironworks and aluminium smelting works (at Skawina). The fact that these works were located in Cracow and Skawina may be regarded as an example of the Polish policy of "passive deglomeration", i.e., the unburdening of the Upper-Silesian Industrial Region (the original intention was to locate the ironworks near Gliwice, and the aluminium works at Jaworzno). Thus it is clear that both Cracow's (and its satellites') industrialization and its industrial "potential" are due to its closeness to Upper Silesia.

TABLE 1. Growth of major industrial centres in Poland

Towns and regions	Share of industrial employment in the number of employed persons (%)*					Increase in the total industrial output (1955 = 100)			
	1955	1957	1960	1965	1970	1957	1960	1965	1970
Warsaw	26.9	28.8	29.4	31.3	31.6	134	222	382	612
Łódź	62.5	61.1	58.9	57.2	54.3	111	135	172	223
Cracow	38.2	39.4	38.1	37.7	36.5	140	197	314	456
Wroclaw	·	43.9	38.4	38.7	38.0	124	171	263	390
Poznań	·	46.1	41.6	40.9	38.0	122	157	227	326
Katowice voivodship	63.3	61.9	59.0	57.7	55.7	110	130	168	218
Poland total	40.8	41.6	41.4	41.8	42.1	120	160	240	358

Source: Rocznik Statystyczny GUS, 1970 and 1971
* Persons employed in the socialised sector of the economy only.

As mentioned at the outset, up to the middle of the 20th century industry had constituted the dominating function of towns. This is no longer so. As in the economy generally, so in towns also is the industrial function gradually giving way to the services (at any rate as regards employment). This is especially conspicuous in North-American and West-European cities (Dickinson 1966). The general growth of productivity due to the advancing mechanization and automation of production processes allows the employment of more people in the services at the expense of industry. This phenomenon has also begun to make itself felt in Poland, but so far only in the biggest cities, (except Warsaw), and in the Upper-Silesian Industrial Region (in the voivodship of Katowice). Since 1957, after the 1950–1956 period of strong extensive industrialization, the advancing industrialization, as evidenced by the growing index of total industrial output, has been matched by a more or less steady decrease in the share of industrial employment in the total economically active population (Table 1 and Fig. 1)

B. THE EFFECT OF INDUSTRY ON THE SPATIAL DEVELOPMENT OF CITIES

The spatial development of towns and cities is determined by two opposite forces — a centripetal and a centrifugal. Industrial activities account for many of these forces, especially the centrifugal ones.

About the end of the 19th century many manufacturing establishments started moving towards the peripheries (or outside) of the towns, which started the general process of urban deconcentration. This industrial migration to the city fringes was mainly due to the rising land rent (which grew in inverse proportion to the distance from the city centre), the lower taxes and less expensive manpower outside the cities, the better situation within the railway network and, finally, to the growing hazards of manufacturing to the environment. In effect this brought about a growth of the population and an urbanization of the suburban settlements, with consequent shifts in the administrative boundaries of the cities. At the same time, though, some industries were concentrating in the city centre or in its immediate vicinity, especially the printing, clothing, food industries and others.

In recent years, however, we again witness a general trend toward a further industrial migration from the city, including those industries that have so far been typical of the city core. This is mainly due to the growing land requirements of modern industry (batch-production, automation, necessity of keeping parking-places for employee's cars, etc.).[3] Accordingly a further spatial expansion of the cities or industrial centres is being observed, and big urban-industrial agglomerations are developing.

The above phenomena are connected with the now universal trend towards suburbanization of industry, affecting the big cities and industrial centres. Whenever the advantages of agglomeration have attained their optimum, any further concentration creates difficulties and complications, e.g., manpower shortage, water deficit, overcharging the transport nodes, the growing hazards of industrial activity to the environment, etc. In other words, what so far may have been the advantages of agglomeration now become disadvantages; hence the necessity of unburdening the big cities. The outward migration of industry proceeds in different ways, e.g., by creating urban-industrial satellites (as around London); by transferring some industrial establishments outside the city (in 1955–1957 about 300 establishments employing altogether 70–80 thousand people left Paris; Dickinson 1966); by putting up isolated, but well-located in the transport system small industrial centres with a full range of services, what in the USA is called Industrial Parks. In the socialist countries, too, degglomeration policies are being conducted in the big cities. But up to now only administrative measures have been employed for this purpose, which have proved rather ineffectual. The socialist economy lacks an adequate economic criterion for measuring the advantages or disadvantages of the agglomeration of industry. Such measurements could be made with the use of land prices, differentiated according to the size of the city, the corresponding costs of services or costs of living, differentiated wages and salaries, etc. (Gruchman 1967). This would make it possible to identify beforehand the threshold beyond which the advantages of agglomeration become disadvantages and thus to enable the degglomeration policies to be more effectively implemented.

[3] E.g., the corresponding index for the newly built establishments in the USA is c. 50 employees per 1 ha of industrial areas (*Readings in Urban Geography*, 1959). In the case of Cracow, for comparison, there were 95 employees per 1 ha of industrial areas (1960), though in the Lenin Ironworks there are only 35 (Kortus 1968).

In the case of the industry of Cracow, in recent years its deconcentration has been proceeding along two lines. The first occurs within the city and consists of transferring predominantly small and technologically obsolete plants from the centre to the periphery. This applied mainly to the historic Old City with its many valuable relics, which has as its main functions tourism and trading and handicraft services. The second type of deconcentration of industry, which Cracow shares with the other big cities of Poland, consists in creating branches or departments of larger plants outside the city as a result of the acute deficit of manpower in the city centres. In 1968–1971, the big establishments of Cracow, including the Lenin Ironworks (Nowa Huta), opened several of these branches in those areas of the voivodships of Cracow and Kielce with surplus manpower. Altogether in 1971 these branches provided about 2000 new workplaces which was impossible in the city of Cracow due to the manpower shortage. Other establishments of this type are going to be put up in the voivodship of Cracow. This is no doubt a favourable trend, as it meets both the deconcentration policies for the big industrial centres and the activation policies for the poorly industrialized and urbanized areas.

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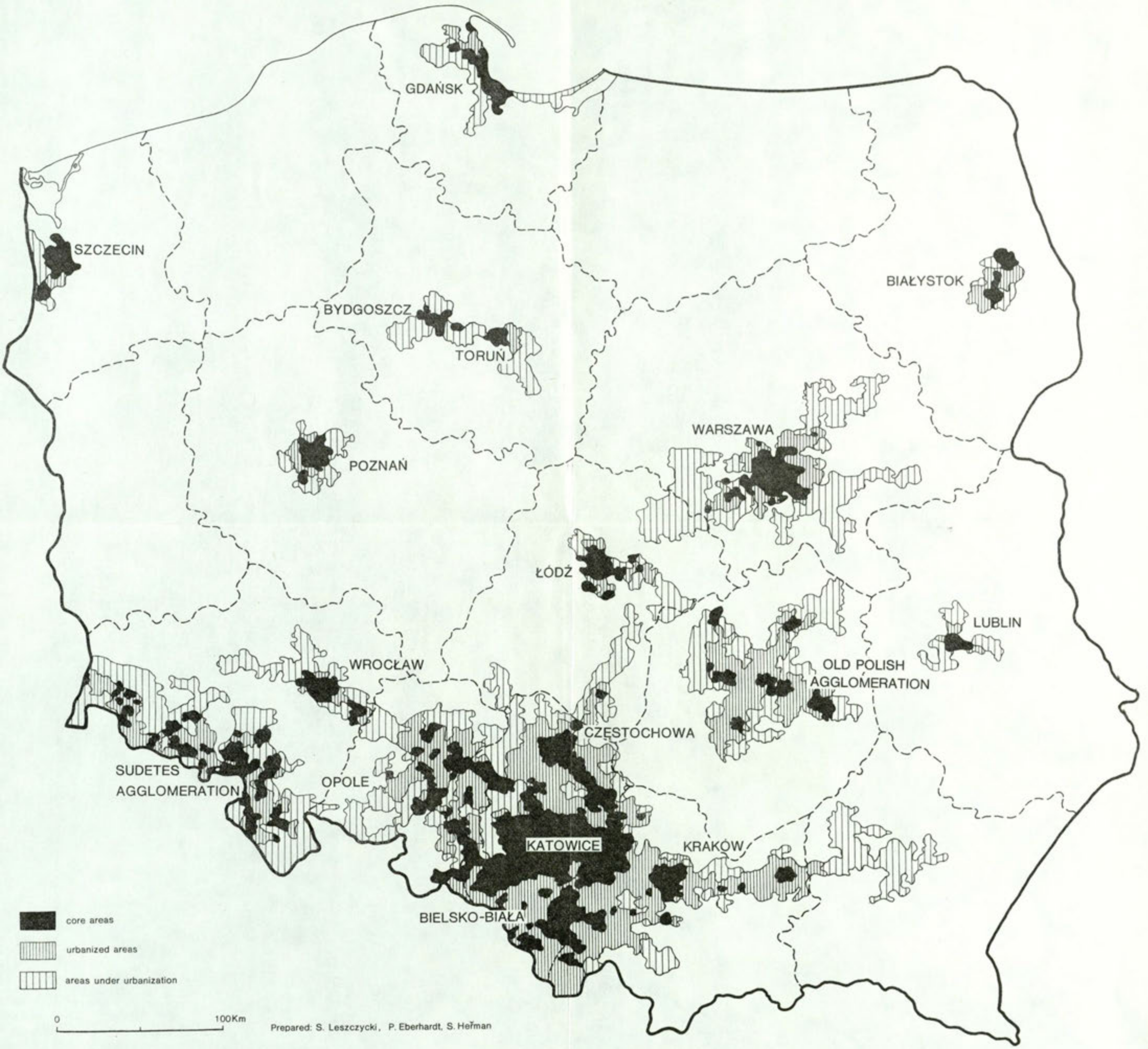

Fig. 1.
Annex to the article by S. Leszczycki, S. Heřman, P. Eberhardt

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