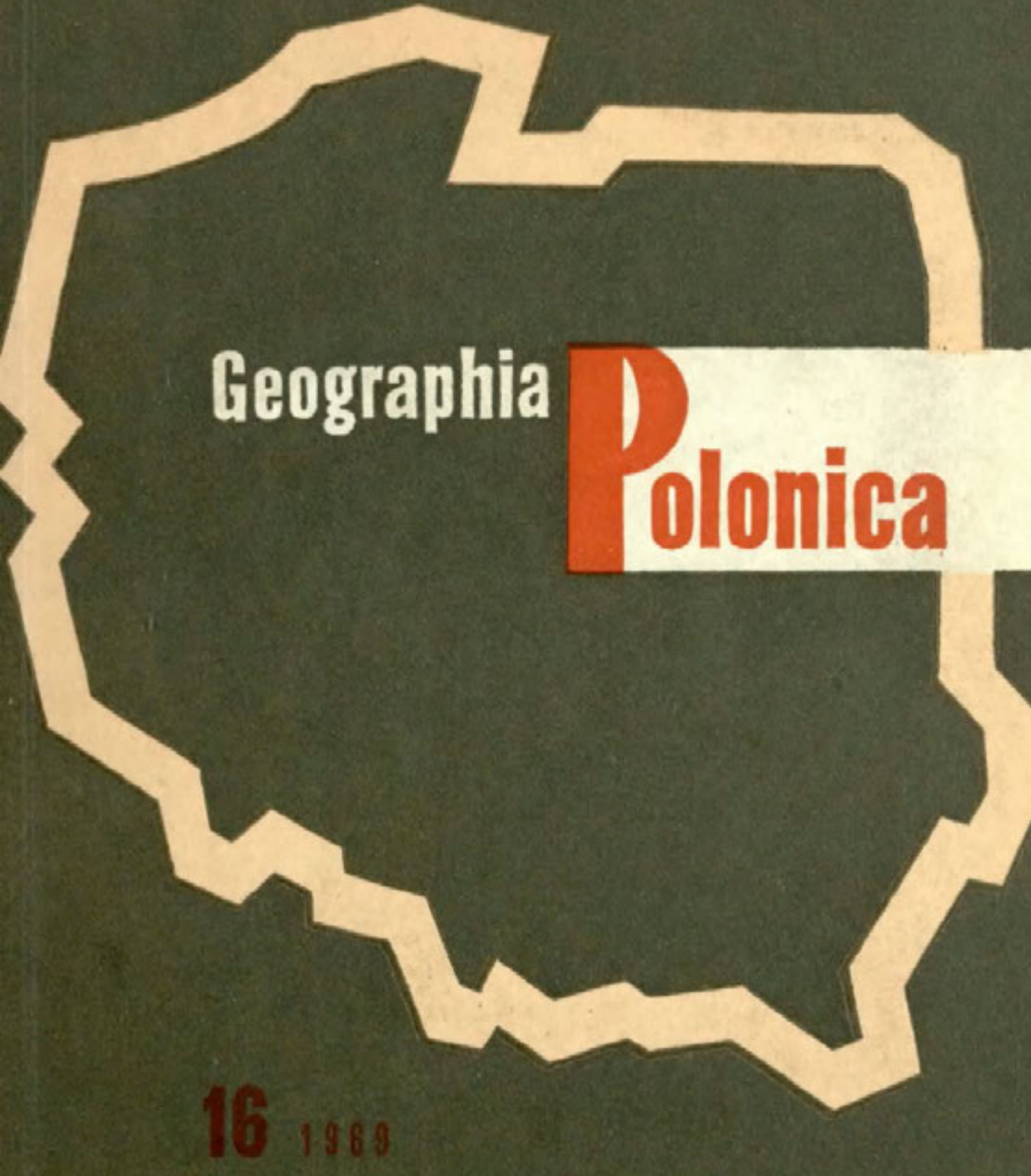
Geographia Polonica



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CONTENTS

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DEVELOPMENT AND REGIONAL PATTERN OF OWNERSHIP FORMS AND SIZE OF FARMS IN THE GERMAN DEMOCRATIC REPUBLIC

WALTER ROUBITSCHEK

INTRODUCTION

In the last two decades the socio-economic structure of agriculture in the G.D.R. has gone through a fundamental change. The process was initiated in 1945 with the Democratic Land Reform. In 1952 the formation of agricultural cooperatives was started. The organisation of all farmers in Agricultural Production Co-operatives (LPG) was finished in the spring of 1960, and since that time the development of large-scale socialist farms has more and more been determined by the technical revolution, industrial production methods and vertical and horizontal co-operative relationships. Foodstuffs are more and more supplied in new forms, which are far beyond all traditional conceptions. These are reasons why a geographical investigation of this variety of changes should be made.

THE DEVELOPMENT OF OWNERSHIP FORMS IN AGRICULTURE ON THE TERRITORY OF THE G.D.R. SINCE 1945

The present pattern of ownership forms and sizes results to a large extent from the structure of land tenure before the Second World War. Table 1 shows the conditions of land tenure in the territory of the G.D.R. after the 1939 census. About 6,300 large farms of more than 100 ha (1 · 1 per cent of all farms larger than 0 · 5 ha) had the same acreage as almost 190,000 family farms of 5—20 ha. These data are a striking evidence for the necessity of the land reform. A regional representation of farm sizes in districts shows the concentration of large estates in Mecklenburg and Hither Pomerania, but also in Brandenburg and Sachsen-Anhalt [1].

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[1] *Statistisches Reichsamt, Deutscher Landwirschaftsatlas,* (Statistical Bureau of the German Reich, German Agricultural Atlas), maps 5—8, Berlin 1939.

TABLE 1. Structure of Farms on the Territory of the G.D.R. in 1959

Size ha	Numbers of farms		Area		Agricultural acreage		Arable land	
	in 1000 ha	in %	in 1000 ha	in %	in 1000 ha	in %	in 1000 ha	in %
A	1	2	3	4	5	6	7	8
0·5 —< 1	118·3	20·7	137·3	1·5	82·1	1·3	56·3	1·1
1 —< 5	202·1	35·3	787·8	8·8	495·8	7·8	335·7	6·8
5 —< 10	94·1	16·4	938·7	10·5	679·1	10·6	508·9	10·2
10 —< 20	95·3	16·6	1,752·4	19·5	1,352·0	21·1	1,055·5	21·2
20 —< 50	48·7	8·5	1,861·2	20·8	1,436·6	22·5	1,120·9	22·5
50 —< 100	8·1	1·4	824·4	9·2	538·1	8·4	426·2	8·6
100 and more	6·3	1·1	2,658·6	29·7	1,812·3	28·3	1,468·4	29·6
Total	572·9	100·0	8,960·4	100·0	6,396·0	100·0	4,971·9	100·0

Source: Collection of papers, *Von der demokratischen Bodenreform zum sozialistischen Dorf* (From the Democratic Land Reform to the Socialistic Village), Berlin 1965, p. 284.

Along the lines of the block of democratic parties, the free trade unions, landless settlers and small peasants, on the territory of the Soviet Occupational Zone, between 1945 and 1949 the Democratic Land Reform was carried out. All private farms of 100 ha and more with their buildings, livestock and deadstock were expropriated as well as the land held by active fascists. Moreover, the state contributed major areas to the funds (Table 2). Most of the land was later on distributed among different owners (Table 3).

TABLE 2. Funds of the Democratic Land Reform on January 1, 1950

Expropriated farms	Number	ha	Percentage
Private land under 100 ha	4,537	131,742	4·0
Private land over 100 ha	7,160	2,517,357	76·3
State-owned land without forests	1,288	337,507	10·2
State-owned forests	384	200,247	6·1
Land settlement associations, fascist institutions	169	22,764	0·7
Other land	551	88,465	2·7
Total	14,089	3,298,082	100·0

Source: as in Table 1, p. 51.

The land handed over to the farmers was unencumbered. Landless peasants and evacuees assisted in many ways, among other things they were given live-stock, dead-stock and long-term loans for buildings. By 1952 about 359,000 houses, sheds, barns and other farm buildings were built for the new peasants. The Land Reform also started a change in the social life of the villages.

TABLE 3. Distribution of land from the funds until January 1, 1950

Recipients	Number of farms	ha
A		
Peasants without land, farm hands	119,121	932,487
Resettlers (evacuees)	91,155	763,596
Small peasants	82,483	274,848
Smallholders	43,231	41,661
Former individual farmers (additional wood lands)	39,838	62,742
Leaseholders of allotments (workers, clerks, etc.)	183,261	114,665
Individual owners total	559,089	2,189,999
State farms, experimental farms, licensed master farms, forestry, democratic agricultural organisations	.	1,010,462
Total, distributed until January 1, 1950		3,200,461

Source: as in Table 1, pp. 52—53, 286.

Table 3 shows that much of the land was passed on to the nationalized large farms. These were former capitalist farms not divided np, because they were highly-developed, specialised (seed growing stations or stock breeding farms). State Farms (VEG) had about 3 per cent of the agricultural acreage in 1945. These model farms were given the task of helping and advising the new farmers in the neighbourhood, providing seeds for them, etc. In the course of the years the share of state-owned farms in the agricultural acreage increased through over-takings of so-called Local Farms (OLB) and other lands. At present it is about 7 per cent of the agricultural acreage in the G.D.R.

Between 1950 and 1952 the pre-war yields per unit area were again reached. The population increase in the G.D.R., however, demanded new developments. More and more it was realised that in the long run the smallholding could not satisfy the growing needs of the population and could not improve the financial position of the smallholder and his family. It preserved the economic and cultural backwardness of rural living conditions.

It is evident also that the development of modern machinery leads to large-scale farming in all parts of the world. In larger farms expenses for means of production per 1 ha of agricultural land are lower and the efficiency of production is greater. Division of labour, specialisation and an increase in productivity on the one hand, and qualification, a rise in the income and culture of the farmers on the other are the outstanding features resulting from an increase in farm size.

Various forms of co-operation were developed. In 1952 there were more than 10,000 tilling, cultivating and harvesting partnerships. When the production of agricultural machinery permitted a higher degree of farm mechanization, the fragmentation in small farm formed an obstacle to the rapid development of productive forces. In the G.D.R. it was not the capitalist way of concentrating agricultural production that was followed, but the formation of large scale socialist farms, when the farmers joined together in co-operatives. The first Agricultural Production Co-operatives were formed in spring 1952. According to the farmers' own conceptions and the conditions existing in the villages three types of agricultural co-operative emerged. Regulations were put down in model articles for co-operatives. The land contributed by the members remains private property, it is inheritable. In compliance with a resolution passed by the general assembly of members, money may be paid out for the land contributed, according to the number of

TABLE 4. Agricultural Production Co-operatives — Characteristic Differences between Type I and III

	Type I	Type III
Contributed land	arable land	arable land, greenland and pastures, forest and other areas
Contributed machinery, implements and buildings	private property, but machinery must be made available against payment	tractors, machinery implements, sheds, barns, etc. are contributed
Contributed livestock	—	draught animals productive livestock
Distribution of income (in money and kind)		
according to production (output)	at least 60%	at least 80%
according to the land contributed	maximum 40%	maximum 20%

ha. The right of using the land has the co-operative. Land improvement may be carried out, large fields may be created, and buildings may be built.

The composition of the various funds in the three types is similar. Special attention must be paid to the fund which is used for improvements and extensions of the co-operative farms. The rate of the development within the co-operative and the increase of the income of its members are dependent on the amount allocated to this fund. An additional source of income may be an individual farm of up to 0·5 ha arable land and orchards as well as individual stock-farming.

The two essential types are Agricultural Production Co-operatives of Types I and III. Type II is a transitional form. The most important differences between the two types will be summed up in Table 4.

In addition to Agricultural Production Co-operatives, Horticultural Production Co-operatives (GPG) emerged when gardeners, horticultural workers and farm labourers joined together. They are socialist co-operatives, in the degree of collectivization corresponding to the Type III of Agricultural Production Co-operatives. So all the land including glass houses, areas under glass, etc. is used by the horticultural co-operative.

Every year more farmers joined the existing co-operatives or formed new ones. Toward the end of 1959 there were 9.566 agricultural co-operatives, which cultivated 40·2 per cent of the agricultural acreage [2].

TABLE 5. Number of farms and an average farm size in various ownership forms in 1962 and 1965

Ownership form	1962			1965		
	Number of farms	Agricultural acreage in ha	Farm size in ha	Number of farms	Agricultural acreage in ha	Farm size in ha
A	1	2	3	4	5	6
VEG	634	409,046	645	660	426,644	646
GPG	366	13,841	38	3[illegible]1	15,829	43
LPG I+1I	10,274	1,845,[illegible]64	185	8,973	1,721,286	192
LPG III	6,351	3,614,377	569	6,166	3,733,988	606
total	17,625	5,883,028	334	16,170	5,897,747	365

Source: Statistical Yearbook of the G.D.R. 1966, pp. 259, 261.

[2] Quoted from V. Klemm, Die Entwicklung der Landwirtschaft der DDR seit der II. Parteikonferenz der SED — Juli 1952, (The Development of Agriculture in the G.D.R. since the II. Party Congress of the Socialist Unity Party — July 1952), *Zeitschr. f. Agrarök.*, 10 (1967), pp. 227—237. Further detailes on agricultural policy may be obtained from this paper.

A meeting of the Central Committee of the Socialist Unity Party on January 27, 1960 was devoted to the enlistment of all farmers in co-operatives. By the beginning of April hundreds of thousands of farmers, particularly in the stock-breeding districts of Gera, Suhl, Karl-Marx-Stadt and Dresden, joined existing co-operatives or formed new co-operatives (mainly Type I). The social foundations for an all-round development of agriculture were thus created[3]. Farms of different ownership forms and their development between 1960 and today are shown in Table 5, the years 1962 and 1965 serving as an example.

Table 5 demonstrates that the ownership pattern after the formation of co-operatives was completed has not changed fundamentally in the last seven years. Thus the situation of autumn 1962, as shown in the map, is still valid. A tendency towards an increase in farm size is also revealed, Type I co-operatives joined together or merged with Type III co-operatives. The data in Table 6 illustrate a considerable difference in farm size between the two types of agricultural co-operatives and show even more clearly the tendency towards an increase in farm size (Table 6). A total of 5,986,412 ha or 93 · 88 per cent of the 6,376,384 ha of agricultural acreage of the G.D.R. in 1965 belonged to socialist farms. 95 per cent of the area in Type III co-operatives and 73 per cent in Type I co-operatives were used by the co-operatives, the rest by individual members.

After most of the agricultural land in the communities of the G.D.R.

TABLE 6. Grouping of Agricultural Co-operatives and their members according to farm size 1962 and 1965

Farm area	Typ I co-operative				Typ III co-operative			
in ha	farms		members		farms		members	
	1962	1965	1962	1965	1962	1965	1962	1965
A	1	2	3	4	5	6	7	8
200	7,021	5,844	141,847	121,509	1,073	753	29,359	21,865
200 — < 500	2,845	2,701	166,170	161,771	2,329	2,315	139,862	145,850
500 < 1000	384	405	47,559	51,437	2,086	2,152	244,708	259,729
1000 — < 2000	24	45	5,649	6,061	794	885	171,718	193,943
2000 and more	—	—	—	—	69	61	26,982	24,457
Total	10,274	8,973	361,225	340,778	6,351	6,166	612,629	645,844

Source: *Statistical Yearbook of the G.D.R.*, 1963, p. 230, 1966, p. 262.

[3] Collection of papers, *Geschichte der deutschen Arbeiterbewegung*, (History of the German Labour Movement), Berlin 1966, 8, p. 204.

was cultivated by large socialist farms, the Agricultural Machine Lending Stations (MAS) and Machinery and Tractor Stations (MTS) had fulfilled their task of being a technical, political and cultural centre in the village. Since 1959 more and more of their machines and implements have been lent to co-operatives and finally sold to them. The tractor drivers became members of the co-operatives. The Machinery and Tractor Stations were transformed into Repair Stations (RTS). In 1964 their tasks were taken over by District Enterprises for Agricultural Engineering (Kreisbetriebe für Landtechnik).

REGIONAL PATTERN OF THE OWNERSHIP FORMS AND THE FARM SIZE

Here the enclosed map of "Prevailing Ownership Forms and Farm Sizes of Socialist Agriculture in the Communities of the G.D.R. on September 30, 1962" will bei discussed. As the legend says, the ownership forms have been grouped according to the agricultural acreage of the socialist farms that have their registered seat in the community.

This representation is made necessary by the fact that at present the agricultural acreage of a farm is given by statistics only according to the "farm principle" [4]. The subgroups representing shares in the agricultural acreage of the community of more than 80 per cent, 60 to 80 per cent and less than 60 per cent permit an evaluation of the local significance of the various ownership forms.

As there are only few cases where a state farm is smaller than a co-operative, the second most important ownership form did not have to be marked on the map. Consequently the areas not utilized by Type III co-operatives in a community dominated by it are cultivated by Type I co-operatives and vice versa. Thus a gradual transition is achieved from the group of 80 and more per cent agricultural acreage in Type I co-operatives (green) via the colours palegreen-yellowish green — yellow — ochre to the communities marked brown in which 80 and more per cent of the agricultural acreage is cultivated by Type III co-operatives (see map enclosed).

State farms, which represent the highest form of national property,

[4] Areas of an agricultural co-operative or a state farm situated in a neighbouring community B are given at the seat of the farm in the community A. This may result in some cases in an inaccurate geographical representation of the situation in a community, or another ownership form may become predominant. Thus it will be necessary to draw maps showing farm boundaries in order to get a correct cartographical representation. These and related problems will be discussed by the author in another paper.

are brought into prominence by red colour. Thus they are also better visible in their island-like occurrence. In accordance with their origin they dominate in the North and on the better soils of the South. In the highlands where smallholdings and subsidiary earning predominated in former times, they are hardly to be found.

The choice of colours for agricultural co-operatives is meant to emphasize the strong dependence of these ownership forms on the tendency of production and on natural conditions. Type III co-operatives mainly occur in areas where the natural conditions are favourable for large-scale farming, i.e. mainly in crop-farming plains. Another reason might have been the favourable conditions for Type III co-operatives in areas with large estates. Type I co-operatives are predominant in the highlands and their forelands, which are characterized by stock-breeding, in lowlands and in areas with former subsidiary earning. These motives become evident in a comparison between the Eichsfeld and the Thuringian basin or between the Harz Mountains and their foreland. The Lommatzscher Pflege or the Altenburg district stand out from the surrounding country through a high concentration of Type III co-operatives. These relations become evident when a comparison is made with the proportion of arable land to pasture, the natural quality of the arable land, or the rate of cattle breeding [5].

The farmers in the regions of Suhl, Gera, Karl-Marx-Stadt and Dresden decided on the formation of Type I co-operatives in spring 1960. In addition to the strong ties of the farmers with their soil and some subjective reasons, the mountainous location, which complicated cultivation of large areas, and the small number of buildings suitable for co-operative livestock husbandry played a great part. Moreover varying agrarian politics and varying instructions by local authorities in regions, districts and communities have contributed to the development of one type or another.

The map, of course, takes into account only land-utilizing ownership forms in socialist agriculture, i.e. chiefly co-operatives and state farms.

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[5] W. Roubitschek, Map 6, Acker — Grünland — Verhältnis 1955 und Bonität des Grünlandes der Gemeinden der DDR (Proportion of Arable Land to Pasture Land in 1955 and the Quality of the Pasture Land in the Communities of the G.D.R.), *Mitt. f. Agrargeogr., landw. Regionalplanung und ausl. Landw., 26, Wiss. Z. Univ. Halle*, 17/1968; H. G. Bannorth, W. Roubitschek, Natürliche Standorteinheiten des Ackerlandes der Gemeinden der DDR (Natural Quality of Arable Land in the Communities of the G.D.R.), with a map, *Zeitschr. f. Erdkundeunterr.*, 18 (1966), pp. 143—149; W. Roubitschek, Die räumliche Differenzierung der Viehhaltung in der DDR 1960 (The Regional Pattern of Livestock Husbandry in the G.D.R. in 1960), *Mitt. f. Agrargeogr., landw. Regionalplanung und ausl. Landw., 7, Wiss. Z. Univ. Halle*, 15 (1966), Math.-Nat. Reihe, pp. 381—401, with 3 maps.

Marketing co-operatives, tractor stations, etc. are excluded. As the acreage alone is not a sufficient criterion for the function of horticultural co-operatives, only the number of horticultural co-operatives has been show in the map. They are concentrated in the vegetable growing regions of the G.D.R., around Potsdam, Dresden, the Central Saxon loam areas, Erfurt, Magdeburg, etc.

Furthermore the map in five graded screen shows the acreage of the largest socialist farm of the various communities in the G.D.R. in ha of agricultural land (less than 250, 250 to less than 500, 500 to less than 1000, 1000 to less than 1500, 1500 ha of agricultural land and larger). In a sector of the economy in which the land is used as the chief means of production the acreage is the most essential characteristic of the importance of a farm. Of course, the extent of production, the value of buildings and machinery, manpower per unit of area, etc. must be adequate.

The regional pattern of farm sizes as shown in the map can be explained as follows: first one can record that co-operatives formed very early were mainly the first to be economically independent and thus the ones that grew fastest. Secondly, there is a close interrelationship with the prevailing ownership form on co-operatives.

As Tables 5 and 6 demonstrate, Type I co-operatives are usually much smaller than Type III co-operatives. And finally the acreage of the co-operatives depends very much on the size of a community or village. Still the villages are spheres with a certain centralizing function. That is why the amalgamation of co-operatives within the villages was first of all taken into consideration as a model for a future organisation, rather than an amalgamation of selected farms in various villages in the neighbourhood. Thus the history of land settlement is still exerting a decisive influence on modern trends in agriculture. Above all in the old Saxon settlement areas the size of communities is only a few hundred hectars, in the crop-farming plains of the Börde and in the North of the G.D.R. it is as a rule more than 1000 ha. For these reasons the largest farms are to be found in the regions of Halle-Magdeburg and in the Northern regions.

TRENDS IN SOCIALIST AGRICULTURE. GEOGRAPHICAL CONCLUSIONS

As the tables show, farm sizes and ownership forms have not changed decisively after the formation of co-operatives was completed. The newly formed co-operatives above all passed through a period of economic consolidation. Experience had to be gained in the management of large farms. Besides the reorganisation of production processes, the selection of the management committee needed time. But soon the organisation of the large farms made progress.

Since 1963 the transition to industrial organisation and production as well as the development of co-operation among various co-operatives has been emphasized more and more.

The increasing concentration of production and the increasing use of machinery in the production of food stuffs require intensified interlocking of farms in a horizontal as well as in a vertical direction. Co-operation among agricultural co-operatives aims at further specialization and division of labour, at agricultural complexes for livestock, fertilizers, drying installations, silos etc. On the other hand, starting from the final product, co-operation between agriculture, processing industry and the market is enforced, so that production become more efficient. The legal independence of the co-operating farms is maintained.

As a result of this fundamental change in our agriculture which makes itself felt almost everywhere, a multitude of new territorial relationships is arising. On the one hand they take consideration of functional factors. Vertical interlocking (e.g. purchase of production equipment, marketing of products) aims at optimum conveying distances. Farms near a town specialize in products difficult to carry over longer distances (vegetable, fruit, milk, eggs) and in fattening of pigs. On the other hand natural factors form a basis of specialization and horizontal co-operation. On the Sundische Wiesen the State Farm of Zingst, for example, produces green fodder, ensilages, dries and mills it for its own cattle and that of the neighbouring co-operative of Trinwillershagen and other farms. Fertilizing is done by the agricultural department of the air transport-company "Interflug". Co-operation between farms with different natural conditions for the raising of young stock is wide-spread. Thus crop-farming plains are closely linked to the highlands or the lowlands with their pastures and greenlands. Of course, in former times livestock boarded out, but these possibilities were only sporadically used, whereas nowadays they are very much supported by central planning and may even lead to new forms of organisation and changes in ownership. Thus, e.g. the major part of the greenland in Friedrichsbrunn (Harz) belongs to the Type III co-operative in Quedlinburg. Another tendency is the decrease of arable land on mountain slopes and highlands due to mechanization and the rapid disintegration of the social stratum of farmers with a subsidiary earning in the highlands (Eichsfeld, Thuringian Mountains). These farmers orientated themselves on self-sufficiency. These regions are now being industrialized and opened up for tourism. Besides there are other measures of country planning, e.g. the separation of large areas from agricultural utilization for hygienic reasons in connexion with the water supply on the Rappbode.

In a slightly exaggerated from one could say that up to 1962 the structures of the individual farms were summed up in the co-operatives. But now, the advantages of large-scale socialist production, the possibilities provided by mechanization are fully realized and life in the country is undergoing a fundamental change. The gross output of farms in the G.D.R. was almost 20,000 million M (marks) in 1966, as compared to 6,500 million M in 1950. In the same period manpower in agriculture was reduced to one half. This considerable growth in production per unit of agricultural area and the much more greater advance in production per worker was only made possible by the steadily increasing use of modern production equipment. The raising of the value of agricultural production equipment is estimated at 12,000 to 14,000 million M. Socialist farms have 31,300 million M fundamental capital excluding livestock and woodland [6]. The gross value of production equipment per worker is 50—60,000 M on an average, thus reaching "industrial" dimensions [7]. The G.D.R. has developed into a modern industrial country with intensive agriculture.

On the one hand the regional differences in the outward appearance and disposition of rural settlements as well as in the use of building materials and in the style of farm buildings are gradually disappearing. On the other, however, these tendencies to uniformity are more than balanced by the rapid specialization of agricultural production.

Industrial production, the fast development of productive forces, does not automatically mean a decrease in the dependence on local conditions of agriculture. Certainly it will no longer be possible to start farm planning only with the agricultural acreage of a farm and the quality of the soil (ROSENKRANZ, O., From the Land Reform...). The specialization of the large socialist farms must also be based upon general technical and economic factors, such as the structure of prices, etc. Thus the spectrum of specialization opportunities is essentially

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[6] G. Grüneberg, *Probleme der weiteren Entwicklung der sozialistischen Landwirtschaft in der DDR* (Problems of the Further Development of Socialist Agriculture in the G.D.R.), paper read at the Karl Marx Party College on the 23rd January 1967, privately printed.

[7] O. Rosenkranz, Von der Bodenreform zum sozialistischen landwirtschaftlichen Grossbetrieb (From the Land Reform, to the Large Socialist Farm) *Sitzungsber. d. DAW zu Berlin, Kl. f. Philos., Gesch., Staats-, Rechts- und Wirtschaftswiss.*, 9, 1967.

broadened and the adaptation to natural and economic conditions strengthened. A "one-sided" production as e.g. in the State Farm of Zingst (conditioned by the utilization of natural factors) is unthinkable in a small farm. More and more economic factors must be taken into consideration: proximity to the market, varying spheres of the processing industries, manpower per unit of area, qualification of manpower, and above all the availability of suitable farm buildings.

The significance of this factor can best be described in terms of their gross value. The gross value of the new farm buildings required at present by the agriculture of the G.D.R. is estimated at about 30,000 million marks (ROSENKRANZ, O., From Land Reform...). They are above all intended for livestock husbandry in Type I co-operatives. Up to now animals have frequently been kept in old-fashioned, small stables and sheds. The costs for a modern cow-house are 4000--5000 marks per one cow.

The increased influence of technical and economic factors brings about at dissolution of the homogeneous regions of production which have been dominating up to now. But also a mosaic structure makes possible and requires geographical consideration.

The following deductions may be drawn from the previous statements: If in the future economic geography is to assess correctly territorial problems of agricultural production and if it is to supply useful material for application in practice it will have to enlarge its knowledge of technical and economic factors.

In accordance with the revolutionary trends in agricultural production processes and the separation of residential premises from farm buildings, complex studies of the changes in the functions of the rural settlements are particularly inviting. The re-evaluation of buildings and machinery which was carried out in great detail in the G.D.R. as well as building surveys form a rich source of material for geography. This is at present the field of studies at the Department of Agrarian Geography in the Agricultural Faculty of the University of Halle.

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URBAN GEOGRAPHY IN POLAND: RECENT TRENDS AND ADVANCES

KAZIMIERZ DZIEWOŃSKI

The development of urban geography in Poland has been reviewed several times since the war. It was first presented by K. Dziewoński within the framework of a larger report on the state of population and settlement geography [1] during the 1956 Methodological Conference on Human (Economic) Geography. The research on urban geography undertaken in the inter-war period was considered in detail in an unpublished study by Miss M. Roslaniec [2] in 1955. In 1964 L. Kosiński published an article on "Population and Urban Geography in Poland", covering the main trends of research on the basis of selected books and articles particularly those published from 1954 to 1964 [3]. Finally the bibliography prepared by Mrs J. Jaroszewska [4] is well advanced (with the part on regional urban studies still unfinished).

So far as urban geography is concerned K. Dziewoński classified studies up to 1955 under the following headings: Distribution and structure of population; Comparative analyses of towns, together with typological and regional studies; Monographs on individual cities and towns including studies of the zones of urban influence; Settlement networks; Historical urban geography; Methodological studies. On the other hand

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[1] K. Dziewoński, Geografia osadnictwa i zaludnienia. Dorobek, podstawy teoretyczne i problemy badawcze (Sum. the Geography of Population and Settlement — — Achievements, theoretical basis and plan for research), *Przegl. geogr.*, 28 (1956), pp. 721—764.

[2] M. Rosłaniec, Dorobek polskiej geografii miast w okresie 1918—1939 (The Achievement of Polish Urban Geography in the Period 1918—1939). Typewritten manuscript, p. 126.

[3] L. Kosiński, Population and Urban Geography in Poland., *Geogr. Pol.*, 1, 1964, pp. 79—96.

[4] J. Dziewulska—Jaroszewska, Bibliografia polskiego dorobku w zakresie geografii miast (A Bibliography of Polish Studies in Urban Geography) I. Typewritten manuscript, so far 1060 positions.

Kosiński has classified later research into: Growth and distribution of population in Poland; Studies on the economic stimulation of small towns; Studies of functional structure as a basis for analysing the economic bases of towns; Functional relations between towns and region; Spatial structure of towns and cities; General studies. This move in classification away from general and comprehensive divisions towards those that are more detailed and selective reflects the interests of Polish geographers. The tendency is to concentrate on problems considered to be of specific significance for the development of science and for the practical needs of the Polish community and economy.

In preparing this report on present trends, based on the studies undertaken and published in the last five years (1963—1967) the divisions have to be adjusted once more to fit the further change in interests in the research undertaken. They will be now as follows: (1) Studies of specific types of cities, in particular of small towns as central places, of the functions and structure of medium sized towns, of conurbations and of metropolitan areas; (2) General typological, mainly functional studies; (3) Morphological studies based mainly on land utilization surveys, also studies of urban physiography; (4) Synthetic studies pertaining to the urban geography of the whole of Poland; and finally (5) Theoretical and methodological studies.

STUDIES OF SPECIFIC TYPES OF CITIES

Studies of small towns are traditional in Polish geography. The interest in them was aroused by the "crisis of small towns" and the aim was to find a means of stimulating their growth. However their attraction now seems to be spent. The theme if undertaken at all results in a detailed monograph of the given town and its sphere of influence, thus shifting from urban to regional geography. However in several cases the interest in small towns has developed into a study of the settlement network with special attention to the role of agricultural villages and settlements as central places, small towns being the highest type of settlement taken into account. This problem was specially studied by M. Chilczuk [5], although a number of geographers were somewhat critical of his achievements. The prevailing opinion is that the situation is much more intricate than his research suggest, and demands

[5] M. Chilczuk, Sieć ośrodków więzi społeczno-gospodarczej wsi w Polsce (Sum. Rural Service Centers in Poland). *Prace Geogr. IG PAN*, 45, Warszawa 1963, p. 155.

extensive corrections. None the less his study is the best to be published so far. In addition some interesting studies on a regional level were carried on in the Geographical Institute of Wrocław University [6]. A new element in these studies is their insistence on the existence of "settlement complexes", i.e. integrated functionally interdependent and closed systems of settlements: rural, industrial and urban. A second element is their emphasis on semi-urbanization, i.e. zonal development of urban characteristics in the formally rural settlements.

The interest of geographers has now turned to much larger urban units. Tarnów (present population about 80.0 thousand) has been chosen for the study of a medium sized town by the joint teams of the Institute of Geography of the Polish Academy of Sciences and the chairs of Economic Geography at the Jagellonian University and at the Pedagogical Institute in Cracow. The choice was based on the existence of an excellent geographical monograph [7] from the inter-war period, giving a full picture of the city just before modern industrialization took place. The new survey was concentrated on the functions, structure and urban morphology of the city. It has shown that its industrial importance in the country as a whole, and to foreign trade, is much greater than its existing central functions. The changes in the population structure and in the urban landscape, with the introduction and growth of new elements, also emerge very clearly. The final results are now being edited and will be published as a separate volume in 1970.

In contradistinction to the research on medium sized towns, the largest cities, conurbations and metropolitain areas have so far been subjected to selective and individual studies only. Nevertheless several such studies are worth mentioning here. First we have the doctorate dissertation of Mrs E. Iwanicka-Lyra on the delimitation of the largest

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[6] Problemy ewolucji układów osadniczych na tle procesów urbanizacyjnych w Polsce (Sum. Problems of the Evolution of Settlement Patterns against the background of the Processes of Urbanization in Poland), *Materiały i Studia Zakładu Podstawowych Problemów Architektury, Urbanistyki i Budownictwa*, Ser. IV, 5, Warszawa 1966, p. 202. See in particular articles by S. Golachowski and A. Zagożdżon, Problematyka zespołów osadniczych (Sum. Problems of settlement complexes), *Czas. geogr.*, 35 (1964), pp. 387—398, J. Czarnecka, Dojazdy do pracy jako czynnik więzi w tworzeniu się zespołów produkcyjno-osadniczych (Allées et venues an travail en tant que facteur formant des lieus entre les localités ouvrières), *Acta Universitatis Wratislavensis*, 47, 1966, pp. 3—37.

[7] Z. Simche, *Tarnów i jego okolice* (Tarnów and its Environs), Tarnów 1930, p. XII, 303.

urban agglomerations [8]. Without going into the intricacies of multifactor analysis she developed an interesting method in which several factors are used simultaneously and given a specific weight established for each agglomeration separately. In this way varying conditions and the differing characteristics of individual agglomerations are taken into account in their delimitation. In another dissertation P. Eberhardt [9] attempted an analysis of the importance of the largest cities in the making of an economic region. He found two different kinds of urban agglomerations and their regions in Poland: some agglomerations being the main central places within large provinces and others possessing a specific, functional role in the national economy. At the same time he established a definite lack of areal correlation between the export and import regions of the cities. The balance of external trade of a city takes place within the whole country, the national economy. The urban economies in Poland forms an open economic system, quite dissimilar to the closed system of the national economy.

In connection with the recent publication by the Central Statistical Office of data pertaining to the metropolitan areas, a very interesting discussion is now developing about the correct objective criteria for the definition and delimitation of those areas.

TYPOLOGICAL STUDIES

In recent years typological studies in Polish urban geography have been contributed mainly by S. Lewiński. Three of them may be selected as the most interesting. The first, his doctorate thesis [10], developed the dynamic typology of cities. On the basis of census and other data from the years 1921—1960 Lewiński defined changes in the professional structure nad consequent changes in the functions of the largest Polish cities (together 55 cities, including all towns of over 30 thousand inhabitants and 50% of those with between 25 and 30 thousand). Metho-

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[8] E. Iwanicka-Lyra, Aglomeracje wielkomiejskie w Polsce (Large Urban Agglomerations in Poland), *Prace Geogr.* IG PAN, 76, Warszawa 1969.

[9] P. Eberhardt, Rola wielkich miast w strukturze regionalnej powiązań przestrzennych w Polsce (The Role of Big Cities in the Structure of Regional Relations in Poland), Warszawa 1968, typewritten manuscript, p. 236.

[10] S. Lewiński, Zmiany struktur zawodowych ludności na przykładzie dużych i średnich miast polskich (Changes in the Professional structure of Populations in Large and Middlesized Polish cities), *Instytut Urbanistyki i Architektury, Seria prac własnych*, 106, 1965, p. 172. Also: Changes of Types of Towns, *Geogr. Pol.*, 7, 1965, pp. 95—106.

dologically the study was a step backwards compared with studies such as those of L. Kosiński but this was the direct result of difficulties in obtaining comparable data for various areas and years. The present territory of Poland being divided between three occupying powers; censuses were held in particular regions at different times. However the final results show the continuity in types with growth in importance of the industrial functions, the definite tendency in the largest cities for development of multiple functions and the diminishing of regional differences, in particular between the Western and Eastern parts of the country.

The second study[11] is concerned with the typological classification of cities based on the nature of the journey to work. Here Lewiński's work is most original. He distinguishes three basic classes of cities where (a) balanced (b) outward and (c) inward movements predominate, with a further division according to small, medium and high mobility of population. All these types are unevenly distributed throughout the country with considerable regional divergences. The most recent studies[12] are still only partly published and concern the applications of multifactor analysis in typological research. The author used three varying but somewhat analogous methods i.e. the Wroclaw taxonomy and the multi-factor analysis as defined in two different ways by B.L.J. Berry. The results are basically similar although rather banal or vague. The equally disappointing results obtained earlier by C.A. Moser and W. Scott using parallel methods in their study of British towns[13] show that either we have not yet learnt to use the new method properly or our data are not sufficiently precise, or perhaps we have overestimated the real value of the method. Perhaps Lewiński's studies when finished will settle this problem for us. So far they indicate that the main differentiating factor for Polish cities is formed by the living conditions, in particular the infrastructure.

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[11] S. Lewiński, Dojazdy do pracy jako element typologii miast (Sum. Commuting as an Element in town Typology), *Przegl. geogr.*, 38 (1966), pp. 715—724.

[12] S. Lewiński, Próba zastosowania metody „taksonomii wrocławskiej" do określenia typów miast (Sum. An Attempt at Applying the „Wrocław Taxonomy" Method to Determine the Type of Town"), *Biuletyn Instytutu Urbanistyki i Architektury*, 25, 1967, pp. 59—64.

[13] C. A. Moser and Wolf Scott, British Towns. A statistical study of their social and economic differences. *Centre for Urban Studies 2*, XXI, London 1961, p. 169.

MORPHOLOGICAL STUDIES

Urban morphological studies in Poland have traditionally been the domain of historians of town planning, concerned mainly with the patterns of mediaeval plans and their development. On the other hand geographers limited their research to the topography of urban sites. Since the war some efforts have been made to study land utilization within the town area [14]. Not all these efforts were successful, since they were directly influenced by the needs of town planners, or even undertaken for such purposes. As a result the basic classification of land uses was never properly and critically thought out and developed. The studies became formal and were executed mechanically. The difficulty here lies in establishing the significant uses and characteristics to be studied by field observation and their proper, subsequent generalization for synthetic maps and quantitative measurement. Currently, within the corporate studies of Tarnów already mentioned, an effort is being made by A. Werwicki to overcome the lag in the development of morphological as compared with functional studies. Similarly Mrs J. Grocholska is studying patterns of land uses in the Warsaw Metropolitan Region on the basis of a detailed survey of representative areas and the generalization of the information thus obtained. It is to be hoped that these efforts will prove to be the beginning of a new trend in the study of urban morphology.

Some interesing morphological studies, as yet unpublished, are being developed in Wroclaw by A. Zagożdżon and others. They are concerned with the morphology of the whole settlement network working towards the definition of morphological patterns of the settlement complexes as well as the dynamic types of various kinds of settlement — urban and rural. Another interesting feature of these studies is the delimitation of settlement complexes on the basis of morphological characteristics and data.

Recent increases in research on what is known as "urban physiography" i.e. very detailed surveys of the geographical environment of various towns and cities, provide rich additional material for the new

[14] H. Leonhardt (Migaczowa), Trzebnica. Studium geograficzno-planistyczne (Trzebnica. A geographical and planning study). *Czas. geogr.*, 20 (1950/51), pp. 301—344. J. Rakowicz (Grocholska), Miasto Mrągowo: Środowisko geograficzne, rozwój i użytkowanie ziemi (The Town of Mrągowo: Natural Environment, Development, Land Utilization) in *Studia nad użytkowaniem ziemi w powiecie mrągowskim*, Warszawa 1959, pp. 60—102. J. Rakowicz (Grocholska), Użytkowanie ziemi w mieście Trzcińsko Zdrój (Land Utilization in the Town of Trzcińsko Zdrój), *Dokum. Geogr.*, 2, 1958, pp. 27—45.

approach to the traditional study of urban sites. For example an unfinished doctorate thesis by Mrs T. Kiedrowska-Lijewska compares the role played by topography in the territorial growth and land utilisation of several towns in the Toruń-Eberswald ice marginal streamway (*Pradolina Toruńsko-Eberswaldzka*). These towns are growing quickly from small regional centres into large industrial cities as a result of the location on their outskirts of very large chemical enterprises. Rather difficult natural conditions which vary considerably give rise to a distinctive types of development.

SYNTHETIC STUDIES

Most of the studies in this category have been produced by K. Dziewoński. He has published analyses of processes and patterns of urbanization in Poland for the years 1946—1960, of changes in the urban network during the XIX-th and the XX-th centuries [15] and together with L. Kosiński a large dissertation on the distribution of population in Poland in the years 1900—1960, summing up a series of articles already published [16]. In addition he has written a number of more popular statements [17] on the subject, the best being a chapter in a textbook on the human geography of Poland.

Parallel to these general treatments of problems relevant to the whole territory of Poland there is a number of synthetic studies devoted either to specific regions or to specific types of cities. The former are usually included in regional monographs, many of them concerned with particular voivodships. The best ones recently published deal with the voivodships of Zielona Góra (1961), Koszalin (1965), Białystok (1967)

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[15] 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), pp. 460—508. K. Dziewoński, Urbanization in contemporary Poland, *Geogr. Pol.*, 3, 1964, pp. 37—56. K. Dziewoński, Changes in the urban network of Poland, in: Festschrift Leopold A. Scheidl zum 60 Geburstag. I Teil, *Wiener Geographische Schriften*, 18—23, Wienna 1965, pp. 218—226.

[16] K. Dziewoński and L. Kosiński, Rozwój i rozmieszczenie ludności Polski w XX wieku (Development and Distribution of the Population in Poland in the Twentieth Century), *Ludność Polski Ludowej*, Tom I, Warszawa 1967, p. 314.

[17] K. Dziewoński, Procesy urbanizacyjne (Processes of Urbanization) in *Zarys geografii ekonomicznej Polski*, Warszawa 1967, pp. 83—113.

and Bydgoszcz (1967)[18]. Synthetic descriptions of the geography of small towns have been produced at intervals by M. Kielczewska-Zaleska who in 1964 undertook also an extension of her analysis to the whole of Eastern Central Europe[19].

Taken together all these studies give an interesting panorama of urban geography. The main points may be summarised as follows:

1. In spite of a quasi-permanence of the urban network and urban sites significant evolution takes place in urban patterns, types and structures. This applies to processes of different duration in time: short--term trends are easier to observe but obscure the more important long-term ones.

2. Very sharp regional differences exist in the character and dynamics of urban development. These are due basically to historical processes although indirectly the differences in geographical environment play an important role. Once established, regional differences are very resistant to change although at any given time they may represent completly dissimilar sets of characteristics and structures.

3. The most important feature of the modern changes in urban geography is the growth of interdependance between various elements of the settlement network. In this way competition between cities is superseded by specialization and cooperation. The settlement complexes tend to develop quickly, growing and covering larger and larger tracts of the land.

This phenomenon is difficult to explain on the basis of the central place theory. The traditional approach to urban analysis also becomes inadequate.

THEORETICAL AND METHODOLOGICAL STUDIES

The fifth and last group of studies, which is probably the most important for the development of urban geography, includes both papers

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[18] J. Grzelak and M. Woźniak, Zagadnienia urbanistyczne, odbudowa i stan zagospodarowania (Urban Problems, Reconstruction and their Present State) in *Województwo Zielonogórskie*, Poznań 1961, pp. 247—276. E. Biederman, Osadnictwo (Settlement) in *Województwo Koszalińskie*, Poznań 1965, pp. 171—200. L. Kosiński, Osadnictwo (Settlement) in *Województwo Białostockie*, Lublin 1967, pp. 546—587. E. Kwiatkowska, Miasta (Towns) in *Województwo Bydgoskie*, Poznań 1967, pp. 254—278.

[19] M. Kiełczewska-Zaleska, Changes in the Functions and Structure of Small Towns in Poland, *Geogr. Pol.*, 3, 1964, p. 79—92. M. Kiełczewska-Zaleska, The Definition of Urban and Non-urban Settlements in East-Central Europe. *Geogr. Pol.*, 7, 1965, pp. 5—16.

written specifically to present some theoretical or methodological concepts and those where the theoretical or methodological implications are important but only incidental to the main research purposes of the authors.

In discussing these latter studies we will have to return to some that have already been mentioned.

Two purely theoretical studies recently published should be mentioned here. One by Z. Chojnicki[20] sets out the applications of gravity and potential models in geography. Their importance for urban geography lies in their use for the description and perhaps the simulation of the development of the settlement network. The second, by K. Dziewoński[21], consists of an exhaustive study on the development of the concept of the urban base. By detailed discussion of the methods used in the measurement of the base as well as of the various applications of the concept both in research and in planning, the author has clearly revealed its strength and weakness, achievements and failures. Critical appraisal brought into the open some important assumptions which although never clearly stated are nevertheless implied in the concept. The most important of these is the identification of the city as a specific type of economic region. Discussion of the problem whether modern cities and in particular metropolitan areas are still economic regions brings the author to the role played by specialization as against central functions in the growth of contemporary cities. In this way the concept of the urban economic base is included into the theory of economic regionalization and also used for overcoming the limitations and weaknesses of the theory of central places.

Among the more important of the new concepts and methods developed "ad hoc" during work on specific areas and problems, first place is undoubtedly taken by the idea of a "settlement complex", in particular of an "urban complex" and the methods for its analysis. Although the concept itself was first formulated during the War by the well--known Polish town and regional planner J. Chmielewski when searching for the correct solution to the problems of spatial structure in

[20] Z. Chojnicki, Zastosowanie modeli grawitacji i potencjału w badaniach przestrzenno-ekonomicznych (Sum. The Application of Gravity and Potential Models in Spatial Economic Research) *Studia Komitetu Przestrzennego Zagospodarowania Kraju*, 14, Warszawa 1966, p. 128.

[21] K. Dziewoński, Baza ekonomiczna i struktura funkcjonalna miast. Studium rozwoju pojęć metod i ich zastosowań (Sum. Urban Economic Base and the Functional Structure of Cities. A study of the development of concepts, methods and applications), *Prace Geogr.* IG PAN, 63, Warszawa 1967, p. 135. K. Dziewoński, The Concept of the Urban Economic Base. Overlooked aspects, *Regional Science Association Papers*, 18, 1967, pp. 139—145.

the Warsaw area and was reintroduced in the proposals for urban morphological typology by K. Dziewoński [22], its most interesting applications were developed recently by S. Golachowski and his pupils in Wrocław. Specifically the use of the graph theory for analysis of such a complex is certainly very promising [23].

Finally the second Franco-Polish Geographical Seminar should be mentoned as it was concerned with problems of the formation and planning of urban networks. Certainly the papers presented and the discussions which developed are of great interest, particularly for the development of some basic concepts and common international terminology [24].

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[22] K. Dziewoński, Zagadnienia typologii morfologicznej miast w Polsce (The Problem of Morphological Typology of Towns in Poland), *Czas. geogr.*, 33 (1962), pp. 343—358.

[23] I. Czarnecka, Mèthode des graphes appliquèe dans l'analyse du transport quotidien des travailleurs, *Bull. de l'Académie Polonaise des Sciences, Serie Gèol. et Geogr.*, 15, 1967, pp. 243—249.

[24] Problèmes de formation et d'aménagement du reseau urbain, *Geogr. Pol.*, 12, 1968, p. 298.

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CAPITALS OF THE SOCIALIST COUNTRIES IN EUROPE

LUDWIK STRASZEWICZ

In the socialist countries of Europe as in the majority of west European countries the capitals are the largest cities and the main economic and cultural centres. They are: Warsaw in Poland, Prague in Czechoslovakia, East Berlin in East Germany, Budapest in Hungary, Bucharest in Rumania, Belgrade in Yugoslavia, Sofia in Bulgaria and Tirana in Albania. Five of these cities have over a million inhabitants. East Berlin constitutes one part of a large world metropolis "Grossberlin" inhabited by many million people. Budapest is the largest of all the cities mentioned and has 2 million inhabitants. Warsaw, Bucharest, Prague and East Berlin have over one million inhabitants each. Tirana is a medium sized town and the number of its inhabitants only recently passed the 100 thousand mark.

Old settlements from Roman times, and even more ancient, have been excavated by archaeologists in Budapest, Sofia and Belgrade [1]. If these are disregarded, the majority of capitals in south and south- east Europe, except Prague, became important within the last 500 years.

Prague is the oldest of all these cities. Its history as the capital goes back as far as the 10th century and since the very beginning of the organization of a state in this part of Europe, Prague has been its capital without a break. It was either the political capital of the independent state or when Bohemia lost its freedom — the main centre of national life. In the 13th and 14th centuries it had 50 000 inhabitants and was one of the largest cities in Europe. The first Central European university was founded in Prague in 1348, that is 16 years earlier than in Cracow and 17 years before Vienna. In the 16th and especially in the 17th century Bohemia suffered a political decline. Prague lost its eminent position and became one of the provincial towns of the German Reich.

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[1] In Roman time Belgrade was known as Singidunum; Sofia — Serdica; Budapest — Aquincum.

Fig. 1. Central European Socialist Countries and their Capitals

At that time Warsaw was the capital of a powerful and prosperous country. In the Middle Ages the first Polish capital was Gniezno and then Cracow which competed with Prague in economic and cultural significance. Since the 15th century, when the Polish-Lithuanian union was effective and the area of the state exceeded 1000 sq. km, Cracow was the great political centre in this part of Europe. However, its eccentric position in the large Polish-Lithuanian state induced the king to transfer the royal seat to Warsaw in 1596. From the beginning of the 17th century Warsaw became the true political and cultural centre of the state and a glorious period in the history of the city began. At the close of the 18th century Poland ceased to be a free country. This caused a considerable depopulation of the city and its economic decline.

Hungary, like Poland, has had several capitals in its history. In the early period of the state the kings of Hungary moved the royal court more than once. First Estergom and then Székesfehérvár were the capitals till the 14th century. In the second half of the 14th century the capital was moved to Buda. Pest lying on the other side of the Danube was developing as a craft and trade centre. In the first half of the 16th century both towns came under Turkish rule but this did not interfere with their position as the main centre of national life. After 150 years of Turkish domination they came under the sovereignty of Habsburg rulers. With the reorganization of the Austrian monarchy when Austro-Hungary came into existence in 1867, Budapest regained its position and was the second capital of the state after Vienna. In 1918 Budapest became the capital of independent Hungary [2].

The history of Berlin starts with two slavonic fishermen's settlements which obtained municipal rights in the 13th century and later joined the Hanseatic League [3]. They were made subject to the Brandenburg margraves in the middle of the 15th century, and a hundred years later Berlin became the capital of this state, which lay on the outskirts of the German Reich. When Prussia came into being, Berlin was its capital and after the Franco-Prussian war (1871) it became the capital of the German Reich and the main German political centre. In 1920, after unification with neighbouring settlements, Grossberlin had almost 4 million inhabitants and, according to the Webster Geographical Dictionary, in 1939 it was one of the four largest cities in the world.

Bucharest and Belgrade developed on the whole along very similar lines. Belgrade which is older than Bucharest, was known much earlier in history and was for a short time the capital of the Serbian state in the 15th century. But it did not gain the importance of a cultural or economic centre in the Middle Ages. Both Belgrade and Bucharest, which from the 17th century was the capital of Walachia, were under Turkish rule. Though not independent until the 19th century, the cities had considerable economic and social significance. Bucharest became the capital of independent Rumania in 1861. From 1830 Belgrade

[2] Buda and Pest were united into one city in 1872.

[3] Berlin and Kolln in fact constituted one town as far back as the 14th century but officially they were united at the end of the 16th century.

was the capital of Serbia and after the fall of Austro-Hungary it became the capital of the newly formed Yugoslavian state [4].

Bulgaria became independent in 1877 and two years later Sofia was proclaimed the capital of the new state. The town is old. It flourished in the Middle Ages but during the 500 years of Turkish rule it declined and never regained its former prosperity. In the 19th century it was an insignificant town, smaller than some others in Bulgaria such as Plovdiv or Varna. Now it is a new, developing capital [5].

Tirana is the smallest of all socialist European capitals. It was founded in the 17th century by a Turkish governor. After Albania gained independence in 1912, Tirana became the political centre and

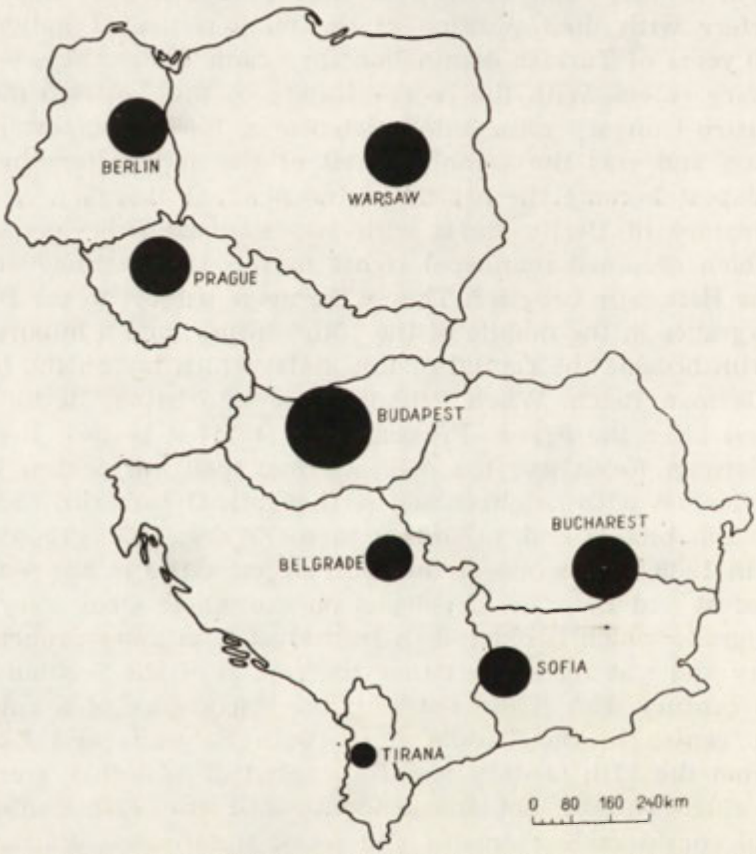

Fig. 2. Capitals of Socialist Countries. 1 sq. mm = 24.000 inhabitants

[4] Originally Yugoslavia was named at that time Kingdom of Serbs-Croats and Slovenians.

[5] Before the Turkish invasion Bulgaria had its capital in Pliska and subsequently in Tirnovo.

in 1920 was proclaimed the capital. At that time there were 15 000 inhabitants.

When speaking of the capitals and their statistical data it should be borne in mind that the municipal area has different meanings in some countries. This follows from the administrative inclusion of the suburban and even neighbouring regions into towns. Consequently the number of a town's inhabitants requires some correction. Thus in 1961 Sofia had 773 thousand people within its administrative borders while the inhabitants of the town itself numbered only 698 000; in 1953 the figures for Belgrade were 475 000 and 377 000 respectively.

TABLE 1. Statistical data for the capitals of the European socialist countries

Year	Country	Capital	Number of inhabitants in thousands	Area in sq. km	Density of people per sq. km
1964	Hungary	Budapest	1935	521	3714
1964	Poland	Warsaw	1241	446	2782
1964	Rumunia	Bucharest *	1239	970	1277
1964	East Germany	East Berlin	1063	403	2637
1964	Czechoslovakia	Prague	1020	185	5514
1963	Bulgaria	Sofia *	731	1124	641
1963	Yugoslavia	Belgrade *	653	629	1038
1964	Albania	Tirana	153	30	5232

* Urban area

Prague presents a different case because its boundaries embrace exclusively the town area of 185 sq. km, the density of population per square kilometre being 5 500 people. The administrative boundaries of Warsaw, Berlin and Budapest include adjoining suburban areas, neighbouring agricultural districts, summer resorts, satellites in the immediate vicinity etc. Warsaw covers 446 sq. km, East Berlin 403 sq. km, Budapest 521 sq. km. By comparison with Prague the mean density of population per square kilometre is much smaller: in Warsaw 2 800, in Berlin 2 600, in Budapest 3 700. The administrative division of the Balkan countries employs the concept of "capital regions" which consist of towns and rather large areas surrounding them. Thus Sofia has an area of 1 124 sq. km, Bucharest 970 sq. km, Belgrade 629 sq. km. The city of Sofia includes 10 adjoining communities. Belgrade consists of the town area of 81 sq. km and suburban territories on both sides of the Sava River as well as large rural localities on the left bank of the Danube. Such extensive municipal areas make the density of population per square kilometre appear much lower than it really is in the city itself. For the whole area of Bucharest it amounts to 1 300, for Sofia 700, and for Belgrade 1 000, whereas in 1953 the city of Belgrade had a density of 5 600 people per square kilometre, neighbouring areas on either side of the Sava 500—700, and the left bank of the Danube no more than 54.

Most capitals in this part of Europe are situated on plains. Berlin and Warsaw are located in prevalley (*pradolina*) areas at 34 m and 100 m respectively above sea level. Berlin lies in the narrow Spree valley and on moraines on both sides of the river. Warsaw occupies the left bank of the Vistula and the town spread along on the much lower right bank in the 19th and 20th centuries. Bucharest also lies in the lowlands, 70—105 m above sea level on the Dembovitza River. Budapest lying on both sides of the Danube occupies the edge of the Hungarian Mittelgebirge. The city is divided into two parts: Pest, which is the central part of the town, stretches out on the flat left bank, whereas Buda is situated on the picturesque hills of the right bank which reach an altitude of about 500 m.

Prague and Belgrade, though built on plains, have remarkably varied relief. Prague lies in the deep Vltava valley and on low hills stretching along both sides of the river, the highest being Vysehrad and Hradcany. The Vltava River flows through the city at 186—176 m above sea level, the highest hill rising some 200—380 m above it.

Belgrade lies at the confluence of the Sava and the Danube on the ledge sloping down to the Danube. The lowest place of the city is 72 m above sea level, the highest 150 m and, Arala Hill, 511 m high, lies within the administrative boundaries. Due to its position in the fork of two rivers, Belgrade has played an important military role in history.

Tirana lies in the marginal zone of the Albanian Mountains, which slope down to the lowland on the sea coast. Sofia is situated in a vast depression 545—625 m above sealevel surrounded by the Balkan Mountains on the north, the Liulin Mts to the west, Srednia Gora to the east and the Vitosha massif to the south. Its altitude is one of the highest among the capitals in this part of Europe. The city rises to the foot of the Vitosha massif which reaches 2 290 m above sea level. The Iskyr River flows several kilometres west of the city.

Of all the cities described Sofia has the most picturesque environment. The mountain ranges, Vitosha national park, and two artificial lakes on the upper Iskyr offer the inhabitants of the city good facilities for recreation. Within 50—100 km there is the splendid countryside of the Balkans with the beautiful gorge of the Iskyr and the mighty peaks of Rila massif rising to a height of 3 000 m above sea level. Recently the development of the iron industry in the immediate neighbourhood of the city with the building of a large foundry at Kremikovtzy may prove detrimental to the harmonious life of Sofia and the health of its inhabitants.

Belgrade and Prague also have beautiful environments. Belgrade, situated on the confluence of the Sava and the Danube, is flanked on the south by gently sloping hills, with the ridges of the Dinaric Alps a little farther off. Prague has a number of well organized summer resorts among the forests and hills along the Vltava and its tributaries the Berounka and the Sazava.

Berlin is deprived of attractive surroundings but there are lakes nearby and woody morainic hills. Warsaw and Budapest lie on large rivers; the latter has a picturesque position on the undulating terrain of Buda and some 100 km away there is the famous Balaton Lake. The inhabitants of Bucharest have the benefit of the Carpathian Mountains not far from the city.

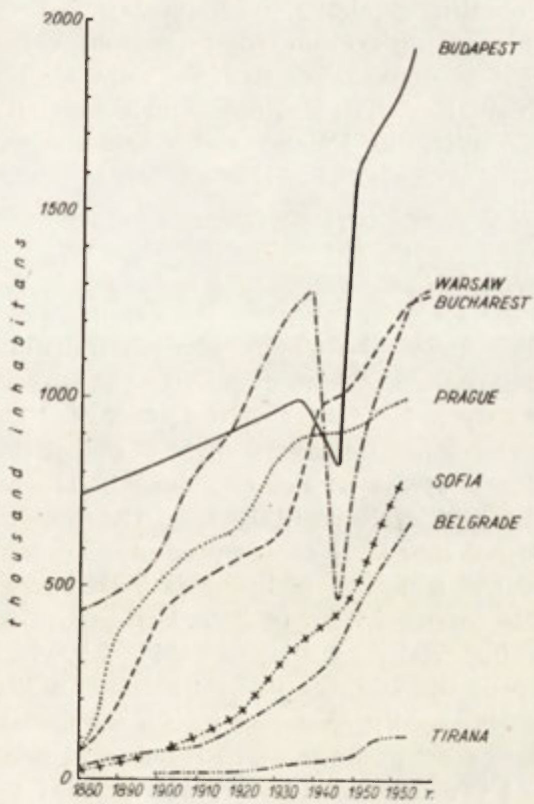

Fig. 3. Growth of Population. Inhabitants in thousands

The development of each of these cities was prompted by the functions and needs characteristic of capitals. This was most striking in the history of Berlin and Sofia. In no other town in the world has the residence of the head of the state and the function of a capital exerted such a decisive influence on development as in Berlin, especially since the second half of the 18th century. Its further economic and industrial prosperity in the 19th century was the result of the political position.

When Sofia with its 20 000 inhabitants became the capital of Bulgaria in 1879, it was a small and insignificant town, much smaller than Plovdiv in economic rank and size. The former Tzar policy as well as the present tendency towards centralization induced people to migrate to the city. This is proved by the fact that 60% of the present inhabitants of Sofia were not born in the city. The rapid development of Belgrade is closely connected with the role of the capital but not to such a degree as in the case of Berlin. It should be remembered that a striking feature of Belgrade is its strategic position.

Although as mentioned above the capitals are the largest cities in the countries under consideration, their position varies accordingly to the settlement system of each country. In Yugoslavia the town of Zagreb is not much smaller than Belgrade and competes with the capital. The situation is similar in Poland and Germany where besides the capitals there are also towns of half a million inhabitants. They are of great economic importance. In Poland Łódź is a large textile centre while Poznań, Cracow and Wroclaw are big provincial towns, as are Leipzig and Dresden in East Germany.

In the remaining socialist countries the capitals predominate in rank and size over other towns. In Czechoslovakia the municipal pattern is well organized but there is a lack of provincial centres. Prague is strictly speaking the only great centre of the country. Brno and Bratislava though big towns have not the significance of provincial centres as have the above mentioned towns in Poland, Yugoslavia and East Germany. The same may be said of Rumania, where the importance of the role played by big towns like Cluj or Iassy cannot be compared with that of Bucharest. Centralization in Bulgaria is even more striking than in Rumania. Two big towns, which used to be larger than Sofia not long ago, are not so important as they would otherwise be because the centralized policy of the country invests money in the development of the capital which is rapidly changing into a wast metropolis.

Centralization is most pronounced in Hungary. Budapest, which developed fully before the first world war, was at that time the centre of a territory much larger than Hungary is today. So now, like Vienna, its size is out of proportion to the size of the country. The majority of economic, social and cultural activities is concentrated here.

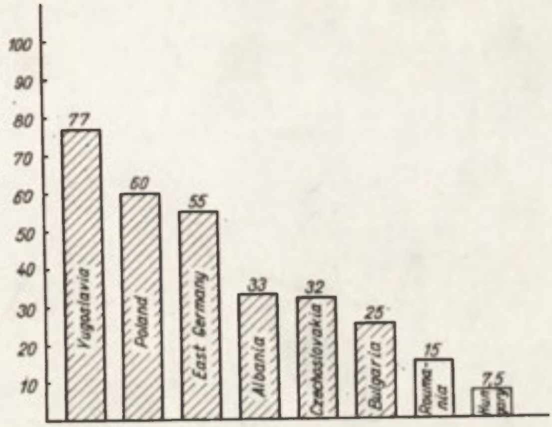

Fig. 4. Index of metropolitan dominancy

The index of metropolitan dominancy has been introduced to illustrate the role of the capital in the settlement pattern of a country. It shows the relation of the capital's size to that of the second largest town in the country. The population of the capital is given the value 100 and the index for Yugoslavia is then 77, for Poland — 60, for East Germany — 55, for Albania — 33, for Czechoslovakia — 32, for Bulgaria — 25, for Rumania — 15, and for Hungary only 7·5.

Though it was the political significance of these towns which gave rise to their development, their present industrial function is the main factor in their activity. They are all industrial centres, chiefly of the machine and electric industries. Berlin has been for a long time a world centre of the electrical and clothing industries. Budapest represents a centre for machinery and means of transport, Prague has its old traditions of metal working. Bucharest has recently developed metal, chemical and textile production. Sofia is a new electric and textile centre. In Warsaw, rebuilt after the Second World War, there are many factories of various branches but chiefly electrical and machine ones. As a rule, the industries characteristic of big towns are concentrated in capitals, especially the polygraphic, pharmaceutic and cosmetic industries.

Berlin, Warsaw, Budapest and Belgrade have no raw materials in their neighbourhood. There are coal-fields in the close vicinity of Prague at Kladno, and of Sofia at Pernik. The exploitation of the iron ore at Kremikovtzy near Sofia has also been started. The fuel for Bucharest is supplied by pipe-line from the petroleum fields nearby.

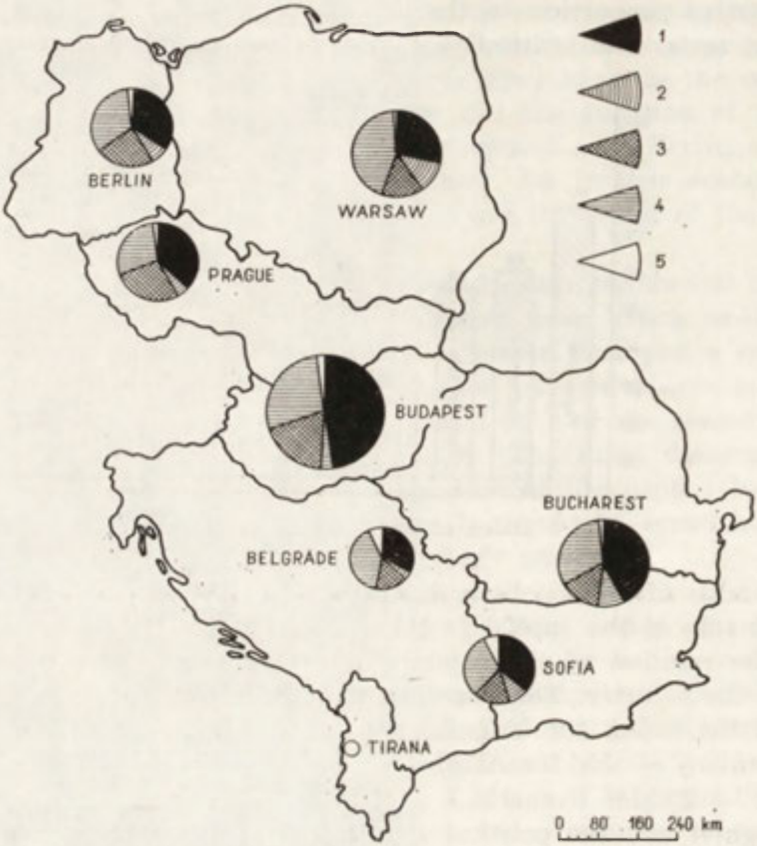

Fig. 5. Professional Structure. 1. Industry. 2. Building industry. 3. Trade and communication. 4. Others: services etc., excluding agriculture. 5. Agriculture

TABLE 2. Professional structure of the population

Capital	Date of census	Percentage of the population earning its living from:				
		Industry	Building industry	Trade and communication	Agriculture	Others (services etc.)
Warsaw	1964	28·2	11·8	15·7	1·6	42·7
Belgrade	1953	31·9	4·4	17·3	5·8	40·6
East Berlin	1962	33·0	7·0	25·0	1·0	34·0
Sofia	1955	35·0	10·2	16·8	6·8	31·2
Prague	1954	36·3	4·6	28·6	1·5	29·0
Bucharest	1961	41·9	10·4	14·9	1·5	31·3
Budapest	1959	47·9	3·2	19·0	1·6	18·3

In Budapest almost half of the inhabitants earn their living by working in industry; in Prague, Sofia and Bucharest — over one third; in Berlin and Belgrade a little less; in Warsaw the index of industrial employment is the lowest because the city was completely destroyed during the second world war and is still being rebuilt: it has the highest proportion of inhabitants employed in the building industry. Sofia and Bucharest also have high indices for building workers, whereas in Prague, Belgrade and Budapest these indices are lower by a factor of two. From 14·9 to 28·6% of the populations are employed in trade and transport, the lowest indices being observed in Bucharest and Warsaw, the highest in Prague.

Most of the capitals play an important role in communication. Four of them: Budapest, Belgrade, Warsaw and Prague lie on river banks. Budapest and Belgrade are Danube ports, Prague is connected through the Vltava with the Laba system. The economic life of Warsaw does not gain much from water communication. The Spree, though a small river, has a net of canals which provide good water routes to Berlin.

All these towns have important railway junctions and some of them are placed on international routes, e.g. Berlin and Warsaw lie on the line joining Paris with Moscow; Sofia on the line between Paris and Istanbul. Besides through railroads, each of the capitals has a well developed local railway network which joins the metropolis with all larger centres in the country and especially with the localities in the capital's immediate vicinity. The junction stations are currently being modernized, that is electrified. Electrification of the Warsaw railroad net is now complete, while for Prague, Sofia and the others it is partial.

All these capitals have large airports. The largest and most important are in Prague, Budapest, Berlin and Warsaw.

TABLE 3. Railroads

City	Date of constructing the railroad	State of electrification	Number of line directions
Berlin	1838	partially	
Prague	1845	partially	7
Warsaw	1845	entirely	5
Budapest	1846	partially	7
Sofia	1883	partially	5
Bucharest	1869	partially	6
Belgrade	•	partially	4
Tirana	1951	unelectrified	1

TABLE 4. Dates of foundation of the universities

City	Date of foundation	Remarks
Prague	1348	
Budapest	1745	Originally founded at Nagyszombat in 1635
Berlin	1810	
Warsaw	1816	
Bucharest	1864	
Belgrade	1905	
Sofia	1909	Since 1863 a college
Tirana	1957	Since 1883 a college

The capitals are the main cultural centres and their influence often extends even beyond political boundaries. The capital universities assemble the most eminent scientists; sometimes they monopolize the scientific life of the country as do Tirana and to some extent Sofia. Czechoslovakia, Rumania and Hungary have universities in other provincial towns also, but the capital universities play a predominant role. Only in Poland, East Germany and Yugoslavia do the provincial universities have an outstanding position in the scientific life. They are: in Poland — Cracow, Poznań, Wroclaw, Łódź; in East Germany — Leipzig, Dresden and others; in Yugoslavia — Zagreb and Ljubljana.

TABLE 5. Concentration of people in the capitals

Year	Capital	Number of inhabitants in thousands	Population of the country	Index of concentration
1963	Belgrade	653	19065	3·4
1964	Warsaw	1241	31338	4·0
1963	East Berlin	1063	17181	6·2
1964	Bucharest	1239	18927	6·5
1964	Prague	1020	14058	7·3
1963	Sofia	731	8111	8·0
1964	Tirana	153	1814	8·4
1964	Budapest	1935	10120	19·1

Throughout the world there is a tendency for people to concentrate in big centres, especially in the capitals. In Western Europe this is the most pronounced in Great Britain and France. In the European socialist countries the stage of population concentration is different. The index of concentration shows the inhabitants of the capital as a percentage of the whole country population. In Hungary it amounts 19·1 but generally it varies from 7 to 9. The lowest indices are in Yugoslavia (3·4) and in Poland (4·0).

Fig. 6. Index of concentration. Number of inhabitants of capitals as a percentage of the total population. 2 mm radius equal 3·5%

It is clear that although in middle and south-east Europe the capitals of the socialist countries are the main centres of economic and cultural life, their role varies markedly.

The tendency to centralization in the People's Democracies varies. In some of them, as in Poland and Czechoslovakia, it is controlled by government policy to prevent an excessive concentration of people in the capitals. This concentration is not higher than in the countries of Western Europe.

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GEOGRAPHIA POLONICA 16, 1969

SOME SELECTED PROBLEMS OF THE DEVELOPMENT AND STRUCTURE OF CRACOW INDUSTRY

BRONISŁAW KORTUS

Up to the Second World War Cracow was predominantly thought of as a centre of science and culture where manufacturing was giving way to services. After the war radical changes occurred in the city's economic and functional structure. The labour force employed in production (in industry and construction) increased from 32.6 per cent of the total active population in 1931 to 53.4 per cent in 1960. Its population doubled (from 260 thousand to 520 thousand) during 1938—1965, and industrial employment increased fivefold (from 21 thousand it grew to 105 thousand). These facts reveal a great dynamism in the development of Cracow during the past twenty years. The main driving force was industry which has since been playing a leading role in the development of the city.

The intensive industrialization of Cracow after the Second World War started with the location in this city of Poland's greatest postwar industrial investment, i.e. the Lenin Metallurgical Works. Cracow is, therefore, a relatively new industrial centre; however, due to the rapid rate of its postwar industrialization it can be rated among the most important industrial centres in our country (after Upper Silesia, Łódź and Warsaw). Its level of industrialization also equals that of many other European cities (Table 1).

Due to a long crisis which lasted for more than 200 years and separated the heyday of crafts from the industrial period, the continuity of manufacturing traditions in Cracow was interrupted, with two important exceptions. One is printing, which has survived owing to the lasting importance in the development of Cracow of its scientific and cultural role. The Cracow polygraphic industry, which in the 16—17th century occupied a monopolistic position in Poland, even now is surpassed in importance only by Warsaw. The second branch of production to survive is the metal industry (at present this also includes engineering) which occupied a leading position amongst former craft and

TABLE 1. Level of industrialization in Cracow and some other Polish and European cities

Cities	Year	Population in thousands	Employment in industry		Employment in industry and crafts		Percentage share of industrial employment in total active population
			in absolute figures	in percentages of total population	in absolute figures	in percentages of total population	
Cracow	1938[a]	259·0	18 400	7·1	28 000	10·8	
	1938[b]	350·0	20 700	6·0	31 000	9·0	
	1965	520·1	104 468	20·1	110 000	21·2	36·6
Warsaw	1965	1252·6	222 177	17·4	237 325	19·0	31·3
Łódź	„	744·1	214 465	28·6	220 577	29·6	57·2
Wrocław	„	474·2	87 793	18·0	90 922	19·2	38·7
Poznań	„	438·2	92 960	20·7	100 045	22·8	40·9
Leningrad	1960	2997·0	867 000	29·0			46·3
Bratislava	1961	246·8	48 219	19·5			
Brno	1964	327·0		30·8			
Leipzig	1964	586·6	123 676	21·1			39·2
Dresden	„	496·4	97 440	19·6			39·5
Halle	„	278·0	47 326	17·0			31·3
Magdeburg	„	266·3	64 267	24·1			38·3
Jena	„	82·4	26 800	32·5			53·6
Nuremberg	1963	466·2	113 166	24·3	155 454	33·4	
Munich	„	1166·2	181 286	15·5	289 712	24·8	
Hanover	„	567·4	121 390	21·4	163 749	28·0	
Cologne	„	835·9	139 514	16·7			appr. 40·0
Zurich	1960	440·2			80 000	18·0	

[a] Within 1938 boundaries
[b] Within the present boundaries. Source: Statistical yearbooks of respective countries (or cities)

still occupies one in industry today. A certain symbol of such a continuity in the development of the metal industry in Cracow are the Zieleniewski Works (now the Szadkowski Machine-Building Works), founded in 1851 from a former smithy. Because of the exceptional conservatism and intolerance of Cracovian craft guilds in the 18th and 19th centuries this factory is one of the very few examples when a workshop was converted into a factory, a common occurrence in many West European cities where craft guilds were much more liberal.

The expansion of the railways was the factor which shook a great majority of medieval cities out of the lethargy caused by the decline of crafts and trade and pushed them on the road towards rapid economic development. In Galicia, however, the first stage in the expansion of railways brought about some adverse effects as it opened the Galician market for Austrian or Czech wares and thus hampered the development of the local industry. The relatively early development of Cracow into a railway junction (from 1847) did not, therefore, stimulate its economic expansion; it was rare for industrial plants to be founded here because of the railway factor. The majority of industrial works started at that time were oriented towards Cracow or its western, more active, hinterland as a marked for selling their products. After the First World War, in independent Poland, the Cracow railway centre became more attractive for the location of certain larger works producing such goods as cables, tin plates or rubber products, various types of fittings, or of flour mills and glass-works. Some location decisions were also influenced by the proximity of Upper Silesian markets where the conditions for locations were in the interwar period even less favourable.

After the Second World War Cracow became more attractive for industrial locations. First of all because of its position in the national transport network, as it lies on the main east-west railway route of Southern Poland and is linked with the mining and industrial districts of Upper and Lower Silesia and also with the USSR, from where soon after the war the bulk of imported raw materials came. Furthermore, Cracow has at its disposal large reserves of manpower in its nearest hinterland. Consequently this city, and its industry in particular, became an important factor in stimulating the economy of the neighbouring rural districts. Finally some industrial locations (e.g. of the Lenin Metallurgical Works in Cracow) were resolved by a new factor in Poland's national economy, namely they were made as a result of planning decisions taken at governmental level.

Local mineral resources such as sulphur, gypsum, limestones, clays and sands played only a secondary role. Of greater significance were the salt deposits in the neighbouring Wieliczka which became the base for Cracow's basic chemical industry (production of soda since 1906, and phosphate fertilizers since 1948), and partly for tanneries and glass--works. Thus, Cracow industry like the majority of urban industrial centres is mainly based on non-local raw materials, even if they are within easy distance of Cracow and conveniently situated (except iron ores).

SOME ELEMENTS OF INTERLINKAGE AND STRUCTURE OF CRACOW INDUSTRY

In the history of the development of Cracow industry factors that influenced locations have constantly been affected by various changes and their significance has been varying. As the market was quite limited territorially (Southern Poland), this led in Cracow to the development of a varied but not highly specialized industry producing for a wide range of purchasers. This influenced the internal structure of the Cracow industrial centre, which did not develop by means of attracting some related co-operating fields of production, but grew up by way of creating various, often chance industries and enterprises. This resulted in a greatly diversified branch structure which is characteristic of large urban industrial centres, but without some distinct complex features. The industrialization of Cracow after the Second World War (with few exceptions) has not followed the pattern of establishing production links with existing works. All more important new investments, including the Lenin Metallurgical Works, were localized in Cracow not because they were meant to co-operate with existing industries, but primarily because of advantages to their own manufacturing process. Consequently the present structure of industrial production in Cracow is characterised by weak interrelations and therefore we can hardly speak of a Cracow industrial "complex" and have to refer to it as an industrial "centre" or "agglomeration". Within this center there exists a huge and typical metallurgical combine which, however, is hardly linked with other industries by technological or production co-operation [5].

Numerous links exist between the Cracow industries and outside enterprises. This is due, on the one hand, to the great demand of Cracow industry for raw materials, lacking on the spot, and, on the other hand, to the large size of this industrial centre and its outer functions. In terms of the volume of transported goods the closest links are with the southern voivodships (Katowice, Cracow, Wroclaw, Kielce and Opole) which are responsible for 96 per cent of goods carried to Cracow and almost 68 per cent of goods sent from Cracow (Fig. 1) [6]. Out of the voivodships listed above the dominant position should be reserved for Katowice and Cracow and a decisive role is played by the Silesia-Cracow Industrial Region (comprising the area of the coal basin).

The structure of the goods turnover presented in Table 2 reveals that the Silesia-Cracow Industrial Region supplies Cracow first of all with coal (89 per cent, the remaining supplies are from Wałbrzych and include imports from the Donets Basin), limestone (74 per cent), and also with metallurgical products (75 per cent) and with iron and

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„Geographia Polonica", 16
wklejka między s. 44—45

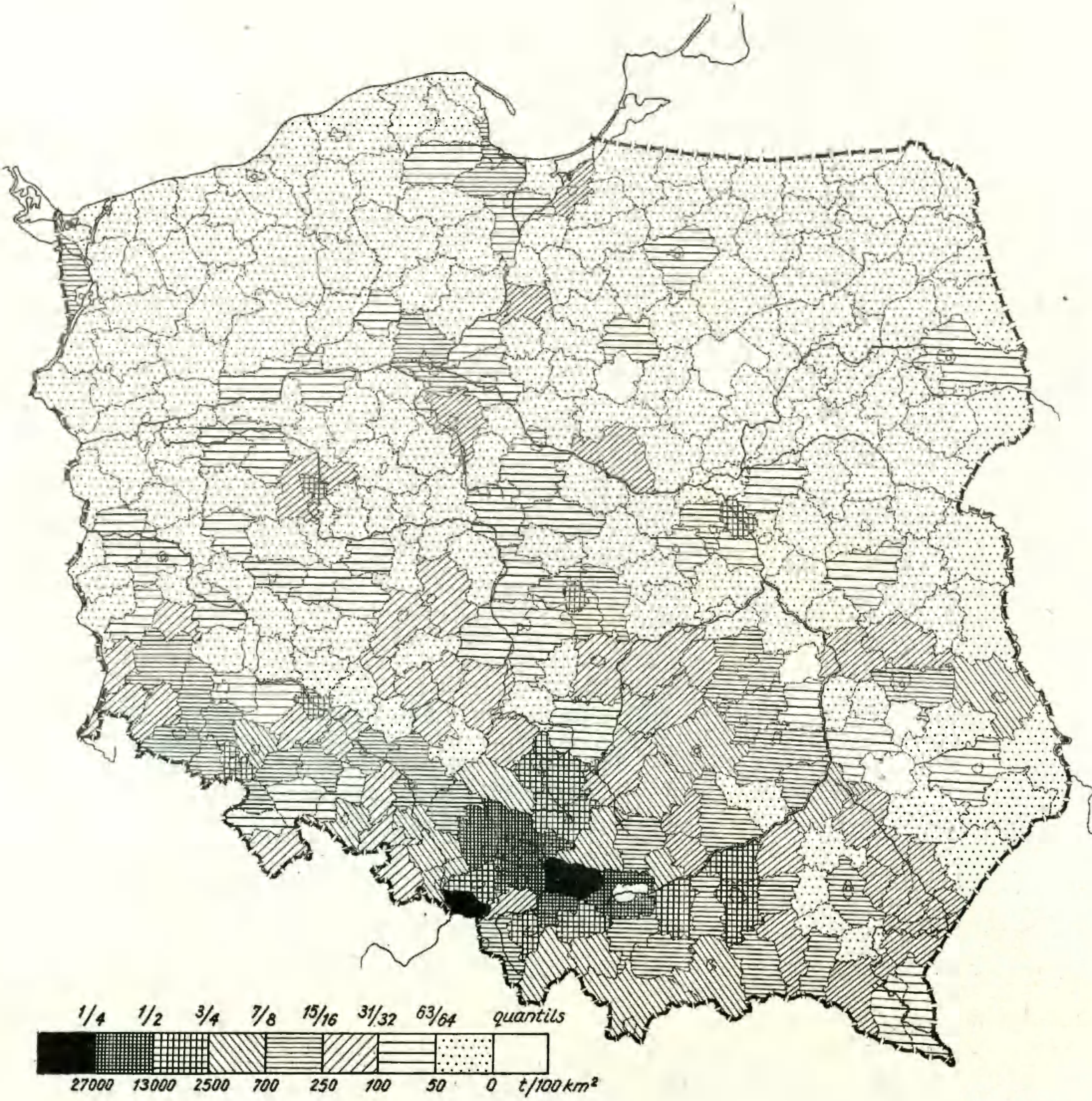

Fig. 1. Spatial concentration of the goods volume (outflow and inflow to Cracow in 1962)

Państwowe Wydawnictwo
Naukowe, 1969 r.

Drukarnia: Pabianickie Zakłady Graficzne
Pabianice, Piotra Skargi 40
Nakład: 710 + 90

TABLE 2. The structure of the goods turnover between Cracow and the Upper Silesia-Cracow Industrial Region in 1962 (in %)

More important groups of goods	The structure of the goods turnover from the Silesia-Cracow Industrial Region		The share of the Silesia-Cracow Industrial Region in the turnover of each group of goods	
	inflow	outflow	inflow	outflow
1	2	3	4	5
coal	52·2	—	89·0	—
coke	1·1	3·2	27·0	18·0
ores	4·3	—	7·0	—
limestone	30·6	—	74·0	—
scrap iron	—	3·6	—	45·0
pig iron and steel	1·7	31·8	78·0	51·0
iron and steel products	1·5	11·3	50·0	17·0
cement	0·2	15·1	43·0	34·0
other buildings materials	0·3	4·7	10·0	20·0
sodium and other chemical products (excluding fertilizers)	1·5	6·3	44·0	25·0
remaining goods	6·6	24·0	—	—
total	100·0	100·0	55·0	29·0

steel products (50 per cent) for Cracow metal and engineering industries which are not produced by the Lenin Works. The amounts of cement, chemical products and heating-coke brought to Cracow from this region are also quite high. Among products supplied by Cracow metallurgical products (51 per cent), scrap iron (45 per cent) and cement (34 per cent) dominate. Thus the strong links of Cracow with the Silesia-Cracow Industrial Region result to a great extent from the co-operation between the Cracow Metallurgical Works and this region (75 per cent of the total tonnage). The fact that at present almost all raw material supplies for the Lenin Works (with the exception of ores) come from the Silesia-Cracow Region, and at the same time a large part of the Works products are dispatched to this region (18 per cent of furnace coke, 51 per cent of semi-manufactured metallurgical products, 34 per cent of cement) proves i.a. that the location of the Lenin Works in Cracow was an economically sound decision.

The present branch structure of Cracow industry (Table 3) has been shaped as a result of complex historical developments and is due to the influence exerted by certain location factors (e.g. the proximity

TABLE 3. Evolution of the branch structure of Cracow industry in the years 1938—1965 (in terms of employment)

Item	Industrial branches	1938	1946	1956	1960	1965	Location coefficient*	
							1938	1965
1	Power industry	3·3	3·0	3·8	5·5	4·7	0·3	0·3
2	Ferrous metallurgy	—	—	16·8	15·4	19·9	—	4·4
3	Metal, machine and electro-technical industries	31·2	33·0	25·7	26·3	27·7	1·4	0·9
	(of which electrotechnical)	7·7	—	—	7·3	7·7	3·5	1·4
4	Chemical	10·0	10·8	10·2	10·0	9·6	1·4	1·5
5	Building materials	2·3	2·6	6·4	5·6	5·0	0·5	1·0
6	Glass	3·2	3·4	2·1	2·3	1·8		1·4
7	Timber	2·6	2·3	2·2	2·0	1·8	0·3	0·4
8	Paper	4·5	2·1	1·4	2·1	1·5	2·0	1·1
9	Printing	6·3	7·5	5·8	4·0	3·6	3·5	3·3
10	Textile	1·9	1·1	1·3	1·4	1·2	0·1	0·1
11	Clothing	6·1	5·7	4·0	5·4	4·6	3·0	1·2
12	Leather	4·3	4·6	3·4	4·7	3·8	2·7	1·2
13	Foodstuffs	23·6	20·5	15·2	13·7	12·9	2·2	1·1
14	Other industries	0·7	3·4	1·7	1·6	1·9	0·9	1·7
	Total	100·0	100·0	100·0	100·0	100·0	×	×
	Industry „A" (1—5)	46·8	49·4	62·9	62·8	66·9	×	×
	Industry „B" (6—14)	53·2	50·6	37·1	37·2	33·1	×	×
	Specialization coefficient (φ_{sp})**	0·84	0·86	0·54	0·50	0·53	×	×

* Location coefficient $loc = \frac{Kx/K}{Px/P}$;

** Specialization coefficient $\varphi_{sp} = \frac{\Sigma(Kx/K - Px/P)}{100}$

where K — Cracow industry, P = Polish industry, x = a given industrial branch (Isard, 1965).

of industrial raw materials such as salt, coal, limestone, etc.). Specific features of this structure are: (a) variety (almost all industrial branches are represented) typical of large urban industrial centres of this type, and (b) the obvious predominance of four industries, i.e. machine — building and metal manufactures (27 per cent of total employment), ferrous metallurgy (19·9 per cent), food (12·9 per cent) and chemical (9·6 per cent) industries. Altogether these four industries employ 70·1 per cent of the total labour force and produce 81 per cent of Cracow manufactures in terms of value. Whereas ferrous metallurgy is a new branch (since 1950) in Cracow industry, the remaining three branches have been developing quite rapidly from the beginning of the present century.

The location of the Lenin Metallurgical Works and of some associated enterprises (mainly the building materials industry) induced some basic shifts in the economic structure of Cracow industry. The share of group "A" increased from 47 per cent in 1938 to 67 per cent in 1965. The expansion of this industrial group involving great capital output was possible only due to vas investment outlays assigned by the State.

Further information on changes which affected the industrial structure of Cracow and that of Poland as a whole is provided by specialization and location coefficients (Table 3). The drop in the value of the specialization coefficient from 0·84 oi 1938 to 0·50 in 1960 is a sign that the industrial structure of Cracow was then closer to the national structure; its subsequent growth to 0·53 in 1965 is the result of the growing one-sidedness of Cracow industry due to the increasing share of ferrous metallurgy. In the light of the location coefficient Cracow has become a nationally important centre of ferrous metallurgy (loc = 4·4) and still is an important printing centre (3·3); chemical (1·5) and electrotechnical (1·4) enterprises are also concentrated there. In relation to 1938 the position of Cracow as a centre of the clothing, leather and paper industries has decreased in significance.

CONCLUSIONS

From the viewpoint of both genesis and structure present urban industrial centres can be divided into two groups:

1. Centres based on local mineral resources; these include mining and industrial towns in districts rich in coal, iron ore and oil deposits, or less frequently towns based on hydropower. In such towns industry was as a rule the primary phenomenon, and the town itself a secondary one. In cases where towns already existed, their structure and functions changed completely under the influence of mining and industry.

2. Old historical cities (lacking as a rule mineral resources) in which the development of industry was a secondary phenomenon, often adjusted to their tradition and historical functions.

Primary industries are typical of the centres belonging to group 1, while cities belonging to group 2 are characterized mostly by manufacturing industries.

The structure and the character of industrial centres of the second type can, however, be modified by the proximity or discovery of industrial raw materials, and they, in turn, may induce the expansion in a given city of some primary industry based on such resources.

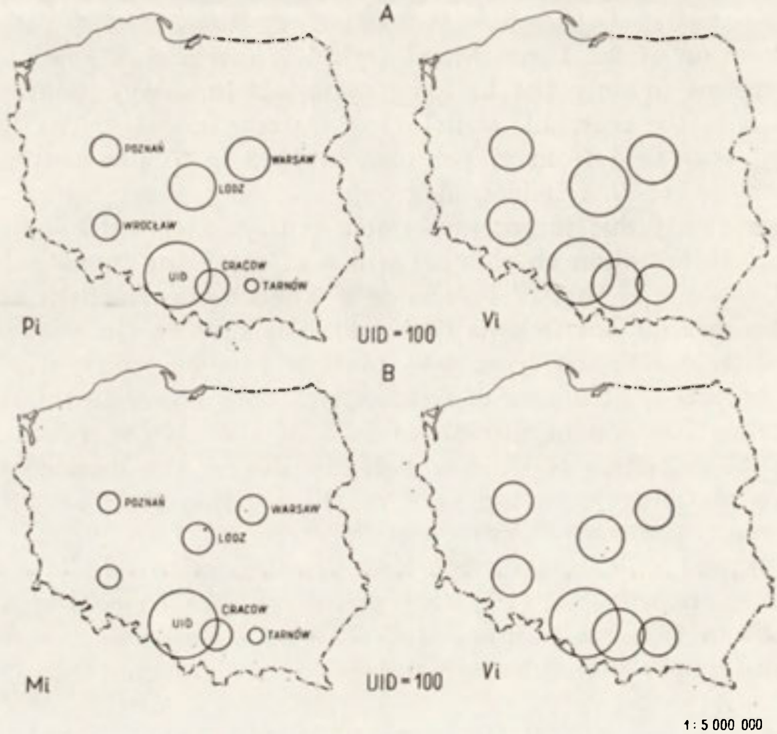

Fig. 2. Size of the selected industrial centres in Poland according to their space potential Vi (compared with respective sizes of traditional measures Pi and Mi)

A — according to the number of employees in industry,
B — according to the value of fixed assets in industry
UID — Upper Silesian Industrial District

Cracow with its industry is an example of such a city. Application of salt as the raw material for the chemical industry and the proximity of the coal-mining and metallurgical base of Upper Silesia have enabled Cracow to develop its basic chemical industry (sodium products, fertilizers), its machine-building and metal industry, which consumes vast amounts of metal, and also its metallurgical and building materials industry. Consequently the share of basic industry in Cracow amounts to 58 per cent in term of the production value or 43 per cent of total employment (1965). This city as an industrial centre lies half way between historical centres with a predominant manufacturing industry and the young mining and industrial centres in which basic industry prevails. Its situation on the peripheries of the Upper Silesian Coal Basin was a decisive factor of such a structure.

In the period of intensive industrialization in Poland after the Second World War Cracow, as a peripheral industrial centre of this type, was allotted a number of industrial investments for which room could not be found in the Upper-Silesian Industrial Region, such as a new metallurgical works, and an aluminium plant (in Skawina). The location of these new enterprises in Cracow and its satellite-town Skawina should be interpreted as a manifestation of the policy of passive deglomeration of the Upper-Silesian Industrial Region (in the original plan the metallurgical works were to be localized near Gliwice, and the aluminium plant in Jaworzno). We can, therefore, conclude that Cracow's great chance (and that of its satellites) to become industrialized, or its industrial "potential", has lain for a long time in its proximity to Upper Silesia. In other terms, this great industrial potential of Cracow (presented in Figure 2), resulting first of all from its proximity to Upper Silesia, constituted a hidden, potential premise for the rapid growth of the Cracow industrial centre after the Second World War.

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AGRICULTURE IN AN INDUSTRIAL DISTRICT (PRESENT STATUS AND TENDENCIES TOWARDS CHANGES IN POLAND)

JOZEF TOBJASZ

In a number of countries problems connected with the evolution of existing and the planning of new industrial districts are a matter of interest to a numerous group of specialists, geographers among them.

In this matter science is confronted with the task of conceiving one or several models how to achieve the best possible economic and functional operation of older industrial districts and how to create new ones.

In new industrial districts now under development, two different models of planned evolution are at present being applied. For them the following pattern can be taken into consideration:

Model One: the formation of an integrated industrial district in which the evolution of all branches of the national economy, including agriculture, is taken into account, — and

Model Two: the evolution of an industrial enclave. giving no heed to or, even, doing harm to agriculture by diverging man power and by extensifying agricultural production. — In Poland, the type predominant is Model One.

The existence and the evolution of an urban-industrial agglomeration brings about an acceleration in the rate of transformations affecting agriculture in the region of this agglomeration and in its surrounding areas as well. The spatial range of the areas directly or indirectly subject to the consequences of an industrial agglomeration is very much diversified. It depends on a variety of factors, such as: the size of the industrial agglomeration, the level of its economic and technical progress, the social division of labour, etc. Well known is the regularity commonly observed: the larger an industrial-urban agglomeration, the wider the spatial range it impinges upon. Of great importance is the degree to which transport and communication facilities of the urban-industrial agglomeration cover the neighbouring and, even, farer distant areas. In cases when the economy and the technical progress in a region or a country is little advanced, the suburban zone of this type of agglomeration stands out by a different, higher standard in the vigour of its economic life, its intensity of corn and vegetable production; on the whole, this suburban zone shows a higher economic development.

Well known are examples of urban-industrial agglomerations existing today: small ones embracing up to 50 000 persons, others of medium-size with up to 500 000, and large ones with more than one million people, for none of which zones of a suburban economy have developed. This sort of phenomenon in which a suburban zone growing vegetable and other agricultural produce is lacking, is usually the result of a generally high technological evolution of a country or region, a well organized system of transport and communication, commodities like warehouses and cold storage plants. Compared with such areas closely adjoining urban-industrial agglomerations which are profiting by the facilities mentioned, areas situated farer away are able to compete by reason of their lower production costs, in spite of increased costs of transport. The result is, that often in closest vicinity to new urban-industrial agglomerations no suburban zone develops supplying local markets with agricultural produce or, that existing older suburban zones next to older agglomerations decline.

The contemporaneous period witnesses a particularly vigorous intensification in the creation and evolution of large urban-industrial agglomerations, because industrialization thrives in the majority of countries of the world. Research on the transformations caused by new agglomerations in the evolution of the zone of its localization is of high theoretical and cognitive value, and the results of such research can be very important for practical application. Further, any knowledge gained (even on a micro-scale) by detailed economo-geographical or geographic-agricultural studies of regions of urban-industrial agglomerations may be of high value in the ultimate selection of sites for new undertakings and in the judicious arrangement of the spatial structure of a planned agglomerations as a whole and in its subdivision. Apparently the most favourable conditions for deciding on the spatial structure of an urban-industrial agglomeration and on the zone it is to occupy vary, depending on the country involved and the type of agglomeration taken into consideration. The reason for this are differences in economical and technological development of individual countries or regions, differences in the territorial division of labour of individual countries, differences in economic, social, ownership etc. conditions, and differences in the technological methods applied in individual agglomerations.

The author uses the term: urban-industrial agglomeration for defining urban, urban-industrial, and purely industrial centres, urbanized and functionally linked with the suburban zones surrounding them (continium) and reaching as far as more distant typical agricultural areas. Every definition of the boundaries and the zone of influence of an urban-industrial agglomeration must be based on criteria of similarities and divergences in economic and natural aspects, conceived in a complex way [1]. In its economic aspects like the range of commuting to work, the agrarian structure, areas supplying the local market of the agglomeration with articles unfit for long-distance transport (fresh vegetables, fruit, fresh milk) which set limits to how far the zone of influence of the agglomeration extends. And it should be kept in mind, that the boundaries of the range of urban-industrial agglomerations are by no means stable; they may widen or grow narrower, depending on the evolution of industry, on economic booms, on changes in technological methods, on progress in automation, etc. In the geographical environment the distribution of industry, in contrast with agriculture, bears a rather punctual character, because usually it is concentrated in the area of a town or settlement. Large agglomerations in the branch of the exploitation of mineral resources and of the heavy industry always lead to permanent changes in the natural environment, — changes for the most part harmful to agriculture. Also transformed are economic conditions in the industrial zone itself and in its nearer and farer vicinity [2].

On the whole, from the viewpoint of agricultural production the effect of an urban-industrial agglomeration upon the geographical environment is unfavourable. This finds its expression, in the first place,

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[2] S. Leszczycki, *Górnośląski Okręg Przemysłowy*. Problemy Badań (The Upper Silesian Industrial District. Problems of Research), Katowice 1959; J. Siuta; *Badania nad Zmianami Warunków Rolniczych w Strefie Zanieczyszczenia Atmosfery Rejonu Puławskiego* (Studies of Changes in Agricultural Conditions in Zone of Air Pollution of Puławy Region), 1967.

in changes in hydrographical conditions, in air pollution by smoke and soot, in the cutting up of the landscape by new road systems, in the curtailment of forested land, etc. However, in spite of the harmful effect of an urban-industrial agglomeration described above, in its favour must be recorded an increase in intensity and productivity of agriculture in the suburban zone, compared with rural areas farer removed. This should be looked upon as economically and socially sound in any country or countries where the market suffers a deficiency in food, and where the urban-industrial agglomeration itself takes care of available reserves of unemployed labour. It seems, moreover, that where the cost of transport and storage is relatively high, the level of technological and economic development of a country or region will act as a powerful stimulant to drawing nearer to the large markets of the urban-industrial agglomeration areas producing food, mainly vegetables, berry-fruit and fresh milk.

When taking into consideration the influence of an urban-industrial agglomeration upon the geographical environment and the landscape surrounding the agglomeration, one can in Poland distinguish at least four different types of agglomerations:

1. Agglomerations for the exploitation of mineral resources: they cause essential changes in the geographical environment — changes usually harmful to vegetable and orchard production. This refers to open-cast and underground mining of bituminous and brown coal, of ore deposits, etc. In Poland to this class of agglomerations belong: the Upper Silesian Industrial Region (in Polish: Górnośląski Okręg Przemysłowy, abbreviated GOP), the Lower Silesian Industrial Region, the regions of Turoszów, Konin, Łęczyca, Lubin, Kielce, etc. All these regions have suffered disturbances in their hydrographical conditions and transformations of soils and vegetation cover. For this kind of regions suitable methods of exploitation of the natural resources must be planned, limiting as much as possible damages to the geographical environment, as well as methods how partly or fully recondition these same regions after exploitation work comes to an end.

2. Agglomerations for the exploitation of other natural resources like crude oil, natural gas, etc.: they usually bring no essential changes on the ground surface and in the geographical environment. In Poland this comprises the regions of Jasło, Ustrzyki Dolne and Dębica-Lubaczów where natural gas strata are being tapped.

3. Agglomerations in the line of heavy industries with an intricate programme of production which, for the most part, uses component parts brought in from elsewhere; an example is the industrial agglomeration

of the Gdańsk—Gdynia—Sopot Tri-City. Here the changes wrought in the geographical environment are negligibly small.

4. The same applies to industrial agglomerations of specialized production, with the predominance of one industrial branch (chemical — as in the expanding Płock district, textile — in the districts of Łódź, Białystok, Bielsko-Biała).

Apart from the four types of industrial agglomerations mentioned there exist intermediate types of a mixed type. The influence which certain types of industries in an urban-industrial agglomeration exert upon transformations of their environment is diversified, but for the most part in similar types of industrial districts the problems arising in the way how natural conditions are affected, are much alike.

In the industrial agglomerations of Poland agriculture shows a series of features in common — the result of the assignement of vast amounts of investment funds to relatively small areas, and of a considerable local concentration of population. In the manner of satisfying the demands of sustenance, industrial agglomerations are inadequate to supply their population with the necessities of daily life, notwithstanding the fact that local agriculture materially contributes in alleviating conditions.

Under the conditions of centralized planning, factors of prime importance in deciding on the most serviceable way how to make use of the territory assigned for an urban-industrial agglomeration are:

1) exploitation of the locally available natural resources like coal, metal ores, etc.,

2) an advantageous arrangement of the individual industrial plants,

3) forethought in setting apart space for lines of transport and communication,

4) allotment of space for the passage of water supply and sewerage lines,

5) selection of the most suitable location for a system of housing developments,

6) clear-sighted reservation of unencumbered space for parks and tree stands — places of collective recreation,

7) conservation of nearby land for purposes of agriculture, horticulture and fruit growing [3].

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[3] S. Leszczycki, *Górnośląski Okręg Przemysłowy* (The Upper Silesian Industrial District), Katowice 1959; Zasadv i Tryb Planowania Regionalnego (Principles and Course of Regional Planning), *Mon. Pol.*, No. 43, of May 2, 1962; M. O. Hanke, *Prigorodnaya Zona Bolshogo Goroda* (The Suburban Zone of Large City), Moskwa 1960; J. Tobjasz; *Rolnictwo Obrzeża Miasta Nowe Tychy* (Agriculture in the Periphery of Nowe Tychy), Warszawa 1962.

Investigations of the structure of crops raised in the discussed industrial districts show certain regularities in a higher share of vegetable and root crops, compared with what is grown in other typically agricultural regions farer away from the urban-industrial agglomerations. This structure of crops, subdivided into five principal groups, is illustraten in Table 3.

The above sequence of factors involved in the appropriate use of the selected site may be considered classified in the order of importance, when it comes to provide space for the variety of branches of the economy. This sequence indicates, that for the most part agricultural activities are treated as a supplementary factor in an industrial district. For all this, its important function in the complex economic use of available space should not be disregarded. Apart from the pure necessity of supplying food, agricultural produce and fruit growing in an industrial district renders three additional important services, by:

1) contributing to a fuller use of the available labour resources, especially by employing women and old-age pensioners.,

2) stimulating production of additional food products, especially of articles unsuited for transport like fresh vegetables, fruit, fresh milk, etc.,

3) improving possibilities of preserving intact the geographical environment by maintaining its biological equilibrium.

It is commonly known that an intensified economic and technological evolution of a whole country or of separate regions may lead to a decrease in the intensity of agricultural production within the limits of the urban-industrial agglomeration or in the zone of influence of this agglomeration. In this matter geographical-economic investigations have been made in GOP and in the Płock and Puławy industrial districts by studies made for selected items of agricultural production and of the way how the land is being utilized. These studies revealed a certain repetition in tendencies and directions of the changes that can be witnessed in recent times; Table 1 illustrates these successive tendencies in the transformation of land use.

The above figures covering the recent 60 years indicate an overall decrease in land under culture, a relatively more rapid decrease in land extensively used for meadows and pastures, and a decrease in forested areas; but, on the other hand, also an increase in space used for remaining purposes and in barren land. Similar are the tendencies in land utilization for the Płock and the Puławy districts, although so far these latter districts are in an evolutionary stage.

Investigations of the man power resources in agriculture of GOP

TABLE 1. Dynamics of land use in GOP, in percent values

Detailed branches of land use	1907	1937	1952	1960	1965
Total	100·0	100·0	100·0	100·0	100·0
Total agricultural land	62·1	58·7	56·5	45·9	41·2
Land under culture	51·8	47·1	43·4	37·6	35·4
Orchards, gardens		1·4	1·8	2·1	2·5
Meadow land	7·7	7·4	7·6	5·1	4·2
Pastures	2·6	2·8	3·7	2·1	1·9
Forests	31·1	29·5	27·6	23·4	22·6
Remaining space and waste land	6·8	11·8	15·9	29·7	33·4

and in the Płock and Puławy districts show fairly high figures for the labour employed per 100 ha agricultural land, as illustrated in Ttable 2.

TABLE 2. Population in agriculture

Per 100 ha the population employed in agriculture is	1960	1965*
GOP	104·6	121·4
Płock district	82·1	93·4
Puławy district	102·1	114·8

* The data given are based on a conversion of official population data, made by the author.

This tabulation shows an increase in the number of people per 100 ha agricultural land use, parallel with a drop in the percentage of agricultural workers in the total figure of the population. Compared with regions of a typical rural character farer removed from the industrial agglomerations mentioned, one notes a considerable increase in the percentage of the population following two occupations (what is called "part-time workers" in English and "crestjan roboczy" in Russian). This class constitutes in the total number of rural holdings: in GOP (1964) 94%, some 64% in the Płock district (1964) and 72% in the Puławy district (1966). In the zone of direct influence of the agglomerations, for a distance up to 10 km from the industrial centre, the combination of work in agriculture and outside of it, is the almost universal rule. It is the men of productive age (from 18 to 59 years old) who work outside of their farms, while agricultural work at home is for the most part attended to by women. It is usually only holdings whose speciality is flower and vegetable raising that no outside (extra-agricultural) work is being looked for.

Investigations of the structure of crops raised in the discussed industrial districts show certain regularities in a higher share of vegetable and root crops, compared with other typically agricultural regions farer away from the urban-industrial agglomerations. This structure of crops, subdivided into five principal groups, is illustrated in Table 3.

TABLE 3. Crop structure

Crop structure in	Corn	Root crops	Industrial and oleagineous plants	Fodder plants	Vegetables
GOP (1964)	53·6	29·1	2·0	9·9	5·4
Płock district	56·2	25·2	4·5	9·8	4·3
Puławy district	59·1	27·1	4·3	5·9	3·6

Also characteristic is the structure of individual crops in the different groups of areas of peasant holdings, illustrated in Table 4.

TABLE 4. Mean figures for crops in GOP, in per-cent (for 1964)

Areas of holdings, in ha	Corn	Root crops	Fodder plants	Vegetables
up to 0·25	53·6	32·8	·	13·6
0·26— 0·50	52·8	41·3	1·3	4·6
0·51— 1·00	51·2	37·8	5·5	4·5
1·01— 1·50	52·0	34·6	5·4	8·0
1·51— 2·00	53·2	33·4	9·7	3·7
2·01— 3·00	55·4	31·4	10·7	2·5
3·01— 5·00	58·8	27·7	10·9	2·8
5·01— 7·00	58·3	26·7	12·4	3·4
7·01—10·00	56·9	27·7	12·7	2·7
10·01—14.00	57·0	27·6	10·7	4·7
more than 14·00	58·6	23·5	14·7	3·2

We note that in the smaller holdings, of less than 5 ha each, the crop structure in GOP shows a higher share of root crops and vegetables than in medium-size holdings (up to 10 ha each) and in larger holdings exceeding 10 ha. Similar are these values determined for the Plock and Puławy districts.

In his further studies the author made use of the structure of land utilization and crops, and of his analysis of the status and the tendency towards livestock breeding, as criteria for assessing types of peasant holdings and for investigating tendencies towards specialization in agricultural production, observed in the investigated industrial districts. From the material gained from these studies it appears, that in Poland these districts show a greater advance in specialized agricultural production in a number of areal groups of peasant holdings. The principal factor affecting a tendency towards specialization in agricultural production is the consideration of the resource of labour per 100 ha agricultural land, available in holdings of different areal extent. Table 5 illustrates these differences in labour working in the individual holdings.

TABLE 5. Mean man power resources in different-size holdings (calculated for 100 ha agricultural land)

Group sizes of holdings	GOP*		Płock district**	
	Czekanów	Tapkowice	Maszewo Małe	Powsino
0·2—0·5 ha	1097	1363	769	·
1—2 ha	162	311	212	159
2—3 ha	158	232	180	66
4—6 ha	72	106	57	42
6—8 ha	·	59	45	18

* From the author's calculations based on poll data (1964).
** From the author's calculations based on poll data (1966).

The vast differences in available labour shown in Table 5 have their bearing upon the different ways of land utilization, upon the tendencies of production, as well as upon productivity and intensity of agricultural work. In the areas under discussion (GOP and the Płock district) it is the smallest holdings which have the greatest labour resources, five to twenty times higher than the larger holdings, per 100 ha agricultural land.

All the above data show that, under the conditions prevailing at present in Poland, agricultural specialization according to H. Thünen's model does not come into play. In an industrial district of Poland, areal specialization of agriculture is for the most part contingent on the ruling agrarian structure and on the labour resources available.

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LA RÉPARTITION ET L'ORIGINE DES FERMES ISOLÉES EN POLOGNE

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L'état actuel de l'habitat rural en Pologne est d'un caractère complexe. Les villages concentrés se mêlent aux fermes isolées. Cet état porte l'empreinte de deux différentes phases du développement d'habitat, liées avec des différents systèmes d'exploitation et de l'organisation de la propriété rurale.

Le réseau des villages concentrés se formait au cours des siècles dans le système de l'assolement triennal, qui se développait au moyen-âge presque dans tout le pays. Jusqu'aujourd'hui le réseau des villages de grandeur moyenne avec des noeuds des routes, est préservé sur une grande partie de la Pologne occidentale orientale, ainsi qu'au nord et c'est justement l'héritage de la période féodale de l'histoire.

Dans les temps modernes, c'est à dire dans le 19-éme et 20-éme siècles, une nouvelle étape du développement a transformé l'habitat rural de la Pologne, qui jusq'alors était presque tout a fait concentré. C'est la dipersion d'habitat qui s'évolua et qui était liée avec une nouvelle technique de culture des terres ainsi qu'avec une autre situation socio-économique des paysans. Les fermes isolées, qui encore au début du 19-éme siècle étaient peu nombreuses, limitées aux quelques petites régions, sont maintenant devenues un élément important dans presque toute la Pologne. Il n'est pas facile de caractériser leur répartition, ce que les études consacrées aux problèmes d'habitat rural ont montré jusqu'à présent.

Les géographes polonais s'occupent depuis longtemps du problème de l'habitat dispersé. C'est déja B. Zaborski [14], qui a attiré l'attention à cette forme d'habitat et qui a essayé de donner une conception très générale de l'apparition de ce genre d'habitat sur sa carte des formes de villages en Pologne. Des études plus détaillées et plus précises sur l'habitat dispersé on été menées dans le cadre et grâce à l'initiative de la Commission de l'Habitat Rural auprès d'IGU, où sous l'influence de A. Demangeon on a entrepris des études comparatives sur les types de l'habitat rural dans le monde [3]. En Pologne on a étudié quelques régions en appliquant des méthodes diverses [1, 4, 6, 9, 10, 13, 15]. Le trait commun de ces études était la tendance à établir le degré de dispersion de l'habitat et à fixer la relation entre l'habitat aggloméré et dispersé. Il y avait aussi des tentatives de saisir avec grande précision l'aspect quantitatif de ce phénomène, mais elles ne sont pas sorties au-delà de l'élaboration de quelques petits exemples.

St. Pawłowski et J. Czekalski ont présenté en 1934, au Congrès International Géographique de Varsovie un essai sur des types d'habitat de toute la Pologne et ont pris en considération aussi la dispersion d'habitat [11]. Mais l'habitat dispersé y est introduit seulement comme un élément du réseau d'habitat et on a caractérisé sa répartition d'une manière très généralisée.

Une meilleure orientation dans la répartition des fermes isolées en Pologne est désirable et nécessaire maintenant, quand on discute très vivement la réorganisation du toute réseau d'habitat rural. Il se pose surtout le problème, si ce type d'habitat et la structure des champs en petits blocs peuvent être adaptés à la culture mécanisée et au régime plus moderne et plus avantageux de certaines formes de l'organisation collective de l'agriculture. Une connaissance approfondie du phénomène aurait un intérêt spécial pour la planification.

Dans le cadre des travaux préparatoires de l'Atlas National de la Pologne je me suis engagée à élaborer une planche caractérisant l'habitat dispersé, qui d'une manière plus exacte approfondira la notion de ce phénomene. L'étude détaillée de la répartition de l'habitat dispersé exige surtout une précision des critères de sa distinction.

La définition du type de l'habitat dispersé a un caractère relatif et dépend en général de la densité d'habitat et des buts pour lequels on étudie ce phénomène. Pour des régions à grande densité de population et au grand nombre et grande densité des localitée, l'habitat dispersé aura d'autres indices de distance que pour les régions à petite densité de la population, où même des distances de 100 et 200 mètres peuvent faire effet de concentration. Ainsi dans les régions peu peuplées de la montagne un habitat éloigné d'une centaine de mètres sur des côtes plus avantageuses ou sur des clairières fait l'impression d'un habitat concentré en comparaison aux régions voisines presqu' inhabitées. Par contre des habitats situées à distance de quelques dizaines de mètres, dans la région à population très dense, comme p.ex. en Belgique, sont en vérité des habitats dispersés [8].

Un phénomène caractéristique pour l'habitat dispersé en Pologne c'est la dispersion des fermes de telle manière' que chaque ferme se trouve au milieu de ses champs et qu'il n'y a pas entre eux de grands espaces sans bâtiments. Pour ce type du régime on ne peut certainement pas fixer de manière rigoureuse une seule distance fixe conventionnelle, audessus de laquelle commence l'habitat dispersé.

Cependant on peut conclure des observations des fermes dispersées, qu'il y a des distances apparaissant le plus souvent, qui sont caractéristiques pour le total du système. Pour la Pologne ce sont des distances qui varient entre 100 et 150 m'etres, ce que j'ai déjà fixé dans mes études précédentes [5]. Cela ne signifie pas qu'il n'y ait pas d'inférieures et très souvent nettement supérieures distances entre les fermes de ce type.

Le nombre indiqué n'est qu'un chiffre d'orientation qui facilite la caractéristique de ce phénomène. Le trait principal pour le type d'habitat dispersé est la dispersion des bâtiments sur tout le terrain appartenant au village, ce qu'on voit dans le paysage. La détermination de l'indice quantitatif était cependant nécessaire dans les calculs détaillés de l'habitat que j'ai entrepris pour toute la Pologne.

Pour obtenir une image exacte de la répartition des fermes isolées, j'ai introduit une méthode de calcul exact de toutes les fermes isolées d'après les cartes topographiques pour chaque unité administrative la moindre c'est à dire pour chaque „gromada" (commune). On a considéré comme habitat dispersé toutes les fermes isolées, éloignées de plus de 100 mètres du village aggloméré ou peu concentré et toutes les fermes du village dont le plan est dispersé, aussi quand les distances entre les fermes sont plus petites. Les petits hameaux d'environ 5 maisons d'habitation sont comptés aussi comme habitat dispersé. Par contre on n'a pas consideré comme habitat dispersé des villages à l'agglomération lâche. Cependant, si les fermes sont situées le long des routes à distance dépassant 100—150 mètres, on les compte déjà comme habitat dispersé.

D'après des chiffres absolus on a calculé l'indice relatif du nombre des fermes isolées par kilomètre carré pour chaque „gromada". La méthode de calcul a permis, d'une manière aussi précise que possible, de montrer l'intensification de ce phénomène et sa répartition pour tout le pays. La carte ci-jointe présente les résultats de ce calcul (fig. 1). Elle ne montre cependant pas le degré de concentration d'habitat ni la relation qui existe entre l'habitat concentré et dispersé, et par ce détail elle diffère des travaux précédents de St. Pawłowski, de A. Zierhoffer [16], et d'autres qui ont tenté d'indiquer les villages concentrés autant que dispersés ainsi que les proportions entre ces deux formes d'habitat. C'est un problème d'un autre genre dont la présentation n'a pas donné jusqu'à présent de résultats suffisamment exacts.

On a effectué le travail sur la base des cartes topographique à l'echelle de 1 : 100 000 et par conséquent ce travail n'est pas sans erreur résultant de la généralisation de ce phènomène sur les cartes à une telle échelle. Cependant ce n'est pas une erreur trop grande et elle ne déforme pas la totalite du phénomène analysé dans ce travail. La généralisation sur les cartes topographiques à cette échelle concerne surtout l'habitat aggloméré et concentré, tandis que la localisation des fermes isolées, surtout là, où elles sont moins nombreuses, est representéed'une manière plus fidèle, comme les observations comparatives sur place l'ont prouvé. La généralisation a lieu seulement dans les régions à une grande concentration. C'est pourquoi je n'ai pas essayé d'exposer les régions à une concentration de l'habitat dispersé supérieure à celle qui est présentée sur la carte (plus de 4 fermes isolées sur 1 km^2), malgré que de telles régions existent.

Une autre déformation dans la présentation de ce phénomène sur la carte ci-jointe est le résultat de l'unité de base, que j'ai employée. Cette unité était la „gromada" qui en Pologne actuellement compte 3—4 villages de grandeur moyenne de 300 à 500 habitants et de la superficie de 10 à 150 kilomètres carrées.

C'est donc une unité assez grande, qui occupe des régions gèographiques physiques diversees, telles que le fond des vallées, les hauteurs, les côtes des montagnes et mème les sommets.

Les fermes isolées appartenant à la dispersion primaire sont liées de manière assez stricte avec certaines formes du terrain par example avec des vallées postglaciaires, des parties sablonneuses, des marécages à l'embouchure de la Vistule etc., où elles étaient organisées au temps de la colonisation de ces régions. Dans ces régions l'habitat dispersé apparait en concentration supérieure à celle qui est présentés sur la carte. Cependant puisque l'unité de référence était une „gromada" qui dépasse les bornes des unités naturelles, l'image d'une vraie localisation des fermes isolées a été un peu déformée. Les fermes isolées qui sont plus concentrées seulement dans une partie de la surface de la „gromada" ont été calculées en relation à toute la superficie. Malgré tout, la surface de la gromada est assez petite pour pouvoir indiquer les relations et les liaisons avec la physiographie des grandes unités naturelles, comme le prouve la carte.

Le phénomène de la répartition des fermes isolées, que cette carte présente se distingue par de grands contrastes. Les régions à très petit nombre de fermes isolées se trouvent à l'ouest, en Silésie dans les environs d'Opole, dans la région de Lubusz (près de Zielona Góra) près de Szczecin ainsi qu'à l'Est dans les voievodies de Białystok et de Lublin. Par contre le centre de la Pologne montre une plus grande concentration des fermes isolées. Les régions où les fermes isolées apparaissent en plus grande intensité s'étendent à partir des Carpates jusqu'au golfe de Gdańsk. Elles ne forment pas une région uniforme au même degré de dispersion, mais des îles de grande densité de l'habitat dispersé de plus de 5 fermes par kilomètre carré sont liées avec des régions à densité inférieure. Parmi les régions à grande nombre des fermes isolées il faut indiquer surtout la région située au pied et sur les versants des Carpates comme la plus remarquable et la plus grande. Au centre de la Pologne dans la voivodie de Kielce, dans la région minière de Kamienna et près d'Ostrowiec et Skarżysko et aussi ailleurs, par exemple près de Radom la carte montre de nombreuses îles d'habitat dispersé dense. Aussi dans le Mazowsze du nord, dans la terre de Dobrzyń il y a beaucoup de fermes isolées. En Grande Pologne (Wielkopolska) il y en a plus à l'est près de Koło, tandisqu'à l'ouest il y a surtout les terrains sablonneux de Nowy Tomyśl qui sont marqués par une plus grande densité de fermes isolées, et aussi une partie de l'ancienne vallée de la riviére Varta à l'ouest de Gorzów.

En Pologne du nord une plus grande densité de fermes isolées est observées dans la région des lacs, et surtout dans les environs de Suwałki, des lacs de Mazury et de Kaszuby ainsi que dans certaines communes du litoral de la mer Baltique.

La carte en question permet d'apercevoir des régions où les fermes isolées sont très nombreuses. D'autre part cette carte nous permet de s'orienter que ce phénomène est très commun en Pologne. Les calculs faits à l'occasion de l'élaboration de la carte permettent aussi d'indiquer l'aspect quantitatif de ce phénomène: Il y a en Pologne environ 600 mille des fermes isolées (exactement 581.949). Surement ce chiffre n'est pas exagéré à cause du matériel généralisé, qui servait de base du calcul. Néanmoins c'est un chiffre approximatif, qui nous oriente dans l'échelle de ce phénomène. Nous avons en Pologne en somme 2.414.300 exploitations privées de plus de 2 hectares et dans ce nombre 1.322.400 exploitations de plus de 5 hectares en 1960 [12]. Tenant compte, qu'en général les fermes isolées appartiennent aux exploitations plus grandes, occupant une plus grande superficie de terre cultivée, nous voyons que l'échelle du problème et le rôle qu'il joue sont très grands. Les exploitations isolées, dispersées sont d'habitude non seulement plus grandes, mais aussi mieux aménagées, avec des bâtiments plus solides et plus modernes. C'est le résultat donc du processus historique ci-dessus expliqué, qui a influencé le développement de l'habitat dispersé, du fait qu'il est d'origine plus récente.

Périodes de formation de l'habitat dispersé

Du point de vue de genèse il faut distinguer l'habitat dispersé primaire, formé sur des terres en friche, de l'habitat dispersé d'origine récente et secondaire. Cette distinction peut être importante non seulement pour des raisons purement scientifiques, mais aussi utile dans la pratique pour estimer le rôle de ce type d'habitat pour le milieu géographique, qu'il occupe. L'habitat dispersé primaire a surgi des marécages, dans les vallées postglaciaires, sur des terrains sablonneux, peu utilisés jusqu'alors, qui après avoir subi certains processus d'irrigation ou de drainage pouvaient être utilisés comme prairies, pâturages, terre arable. Ce processus commença dans les colonies hollandaises établies déjà vers la fin du 16-ème siècle à l'embouchure de la Vistule. Au cours du 17-ème et surtout au 18-éme siècle le processus de l'aménagement des terres inhabitées et en friche a pris des grandes dimensions et s'est étendu vers des autres vallées postglaciaires de la Pologne centrale.

La carte topographique faite au début du 19-ème siècle permet à saisir l'état et l'étendue de cette vague de colonisation dispersée primaire, malgré qu'on ne peut pas calculer exactement le nombre d'exploitations qui furent formées alors. En comparaison avec le nombre des fermes isolées existant actuellement, leur nombre était petit et les terrains avec l'habitat dispersé primaire ne constituent qu'une petite partie du terrain occupé par l'habitat dispersé contemporain.

La période du développement de l'habitat rural d'origine secondaire commence dans le second quart du 19-ème siècle. Les fermes isolées surgissent sur les terrains, qui jusqu'alors étaient le domaine de l'habitat aggloméré et occupent sa place. C'est une réforme agraire qui rendait les paysans propriétaires de la terre et qui séparait la possession des champs de la grande proprieté, accomplie dans les régions de Wielkopolska et de Pomorze, qui a commencé cette nouvelle période.

Au moment d'une nouvelle répartition de la proprieté rurale, qui jusqu'alors était exploitée en commun par paysans et propriétaire du grand domaine, un nouveau arpentage de la terre eut lieu. Une grande partie des fermes paysannes fut transportée à des nouvelles places, comme colonies isolées, avec leurs champs mesurés à neuf dans une seule parcelle.

Plus tard, le processus de parcellement de la grande propriété, surtout dans la deuxième moitié de 19-ème siècle a développé cette forme d'habitat.

Le parcellement de la grande propriété foncière entrepris pour des raisons diverses, par l'initiative des institutions diverses avait lieu pendant la deuxième moitié du 19-ème siècle et la première moitié du 20-ème siècle. Entre les deux guerres il était encore intensifiée de que l'indépendance a été regagnée. Le gouvernement polonais a décrété le parcellement obligatoire voulant de cette manière réduire le surpeuplement rural et apaiser le besoin de la terre de la population paysanne.

De même après la deuxième guerre mondiale on est parvenu à diviser une partie considérable des terres de grands propriétaires et à construire de nouvelles fermes isolées sur les terres des anciens grands domaines de nouveau arpentés, p.ex. la région de Chełmno où encore récemment l'habitat aggloméré de la grande propriété dominait, possède un grand nombre de fermes isolées construites après la deuxième guerre.

Le troisième processus qui, à un degré, a contribué à la fondation des fermes isolées c'était le remembrement des champs conduit à partir de la fin du 19-ème siècle. Les villages paysans avaient des champs divisés en petites parcelles, dispersés et entremelés à cause des partages de famille et de l'augmentation du nombre des fermes sous la pression démographique surtout au 19-ème siècle. Un propriétaire de quelques hectares avait ses champs dispersés dans des dizaines d'endroits. L'exploitation rationnelle était très difficile surtout quand le système de l'assolement triennal fut remplacé par de nouveaux systèmes plus intensifiés. L'action du remembrement consistait à l'intégration des champs de chaque propriétaire et à la formation de la nouvelle structure en petits blocs. Les nombreuses fermes isolées furent formées à cette occasion, car on construisait de nouveaux bâtiments sur des parcelles integrées. L'habitat dispersé sur les terrains sablonneux de Kurpie fut formé dans la période entre les deux guerres justement comme résultat de cette action et des villages entiers ont subi une transformation complète. Dans toute la Pologne centrale partout où le remembrement avait lieu, le nombre des fermes isolées a beaucoup augmenté.

L'accroissement spontané des fermes isolées grâce au partage de la terre dans la famille et la construction des nouvelles fermes sur des anciennes parcelles éloignées était aussi la cause de l'augmentation de leur nombre. Ceci avait lieu surtout dans les montagnes où les champs en lanièrés étaient faciles à partager en petits blocs.

Ainsi des facteurs differents ont contribué à l'état contemporain de la répartition de l'habitat dispersé et il est difficile sans études détaillées de répondre à la question lequel a joué le rôle décisif. Leur influence et intensité ont été très differentes, dans les régions particuliéres de la Pologne.

Pour la région de Dobrzyń, selon l'étude de E. Kwiatkowska [7] c'était le procès d'occupation des régions inhabitées et le parcellement. L'étude de D. Bodzak [2] prouve que pour le district de Puławy c'est le remembrement qui était décisif. Pour toute la Pologne ce sont probablement le parcellement et le remembrement qui ont été la cause de l'accroissement de l'habitat dispersé plutôt que la colonisation des terres en friche et les partages spontanés. Tout de même ce problème n'a pas encore été vérifié en détail.

En somme il faut souligner le fait, que l'habitat rural dispersé est un phénomène observé en masse dans des nombreuses régions de notre pays. Ce type d'habitat n'est pas un phénomène marginal. Son origine est d'habitude plus récente. Les fermes isolées sont souvent mieux aménagées que les autres exploitations rurales, ce que trouve une résonance dans leur situation économique.

Les phénomènes présentés ici sont très importants pour les travaux de planification. Le plan de la concentration d'habitat rural doit prendre en considération l'obstacle que crée le grand nombre des fermes dispersées.

On peut supposer, que l'introduction du système de l'exploitation socialisée s'accomplira plus rapidement dans les villages agglomérés où des fermes paysannes plus petites et plus faibles vont s'unir dans des exploitations collectives. Par contre les fermes isolées, qui sont relativement plus grandes et mieux aménagées, constituent un meilleur soutien pour l'exploitation individuelle qui dans cette forme d'habitat a trouvé des conditions favorables pour l'existence dans une grande partie du pays.

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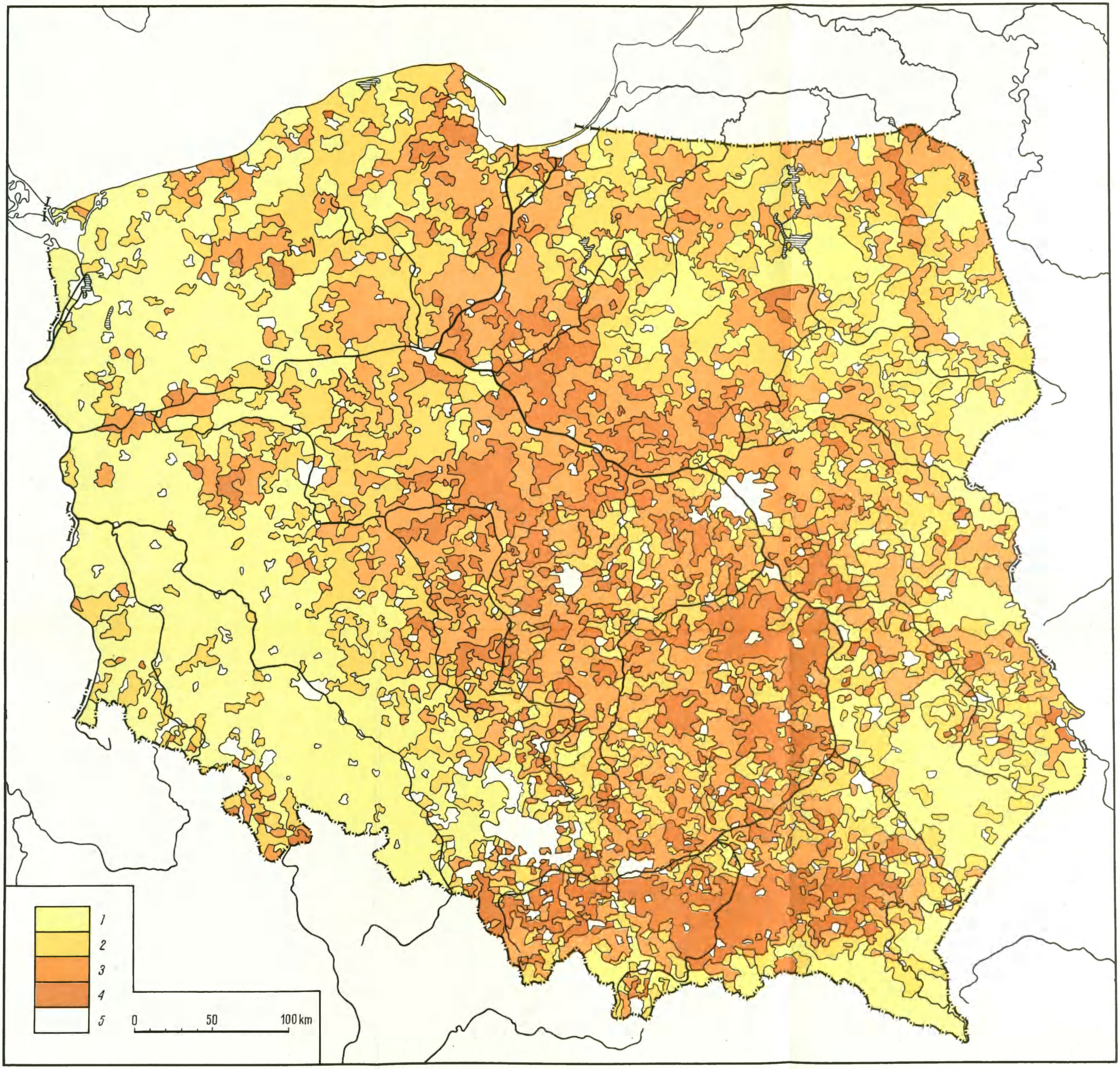

M. Kiełczewska-Zaleska i D. Bodzak

Fig. 1. Les fermes rurales dispersées

1 – moins que 1 ferme par km^2, 2 – 1–2 fermes par km^2, 3 – 2–4 fermes par km^2,
4 – plus des 4 fermes par km^2, 5 – terrains des villes et d'habitat urbain

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THE COMPLEX PRODUCTION INDEX AS A MEANS OF APPRAISING THE RATE OF ECONOMIC GROWTH

JÓZEF BARBAG

Economic potential is usually measured by means of the national income. This method which is applied universally is, however, not perfect although when we use tables containing national incomes of various countries we often are not aware of its deficiencies. Statististical data listed in such tables (like those included in United Nations publications) as a rule present national income in the currencies of the respective countries. Its conversion into a comparable currency, for example the dollar, is difficult as the value and purchasing power of the latter vary not only in time but may not be the same everywhere at the same period of time.

Another and a very essential limitation are methodological differences in the computation of the national income. In socialist countries the national income denotes the net product recalculated of the price value, i. e. it corresponds to the value of that part of the gross product which remains after the deduction of the value of the means of production used for its creation. In a number of countries the national income is understood as the aggregate income of the whole population and of the state, including also services. Different methods of computation naturally reflect upon the results. For example, in Soviet statistics the per capita national income of the United States in 1966 was estimated at 1924 dollars as compared with 2678 dollars in American statistics.

It seems, therefore, advisable to work out and test some other methods of computing economic potential of a country. The method presented below is based upon the complex production index computed from the value of the extractive and manufacturing industries and of agriculture, as the basic branches of the national economy which to a lesser or greater extent determine all other fields of economic activity.

The index is computed by means of the following formula:

$$\frac{1}{z}\left(\sum_{r=1}^{r=z}\frac{x_r(n)\cdot 100}{X_r}\right)=I_n(z)$$

where:

r = the limit of the sum 1 — z;

x = the value of production of selected (z) economic elements of the country n;

X = the world values of production of selected (z) economic elements;

z = the number of economic elements;

I = the complex index for the country n.

In the above formula x is computed from the economic elements (z) of a given country n, x_1, x_2, x_3, x_4, etc., whereby x_1 denotes, for example, electric power production, x_2 — steel production, x_3 — wheat production, x_4 — barley production, X corresponds to the same elements in the world economy (z), for example X_1 — world production of electric power, X_2 — world production of steel, X_3 — world production of wheat, X_4 — world production of barley.

The complex index I is, therefore, an arithmetic (non-weighted) mean of the sum of the percentage share in the world economy of selected economic elements. The index is a quotient; its dividend consists of a sum of quotients representing the values of economic elements of respective countries in terms of the percentage of the base. The base is the value of the same economic elements for the whole world in a given year. The divisor in the number of elements included in the computation.

This complex index can above all be used in the appraisal of the rate of economic growth of a given country, or to be more precise the growth rate of its share in the world economy for some selected periods of time. The appropriate calculations for Poland were made for the years 1955—1965; 108 economic elements were taken into account, 25 concerned with extractive industries, 31 with manufacturing industries, 47 with crop production and 5 with animal production [1].

The number and choice of elements were entirely determined by the scope of statistical material available, both for Poland and the whole

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[1] Economic elements included in the computation:

Industry — 56 elements.

Extractive industries: [25]; 1) fuels, 2) iron ores, 2) manganese ores, 3) zinc ores, 5) copper ores, 6) lead ores, 7) chromium ores, 8) wolfram ores, 9) vanadium ores, 10) tungsten ores, 11) nickel ores, 12) cobalt ores, 13) antimony ores, 14) zinc concentrates, 15) mercury, 16) bauxite, 17) gold, 18) silver, 19) diamonds, 20) asbestos, 21) magnesite, 22) molybdenun, 23) phosphorites, 24) potassium salts, 25) mineral sulphur.

Manufacturing industries: [31]; 1) coke, 2) cement, 3) pig iron, 4) crude steel, 5) copper, 6) zinc, 7) lead, 8) manganese, 9) tin, 10) aluminium, 11) launched ships, 12) motor-cars, 13) lorries, 14) hydrochloric acid, 15) nitrogen fertilizers, 16) po-world. Sources used were: The Statistical Yearbook of the Central Statistical Office, the Yearbook of International Statistics of the Central Statistical Office and the Production Yearbook of the FAO. All economic elements which were included in the above mentioned publications and referred to analyzed economic branches were taken into account during the computation without any selection being made.

TABLE 1. The indexes for 1955 and 1965

Complex production index		Industry			Agriculture		
		total	extractive	manufacturing	total	crop production	animal production
1955 Poland	1·38	0·96	0·46	1·37	1·82	1·83	1·75
1965 Poland	1·70	1·11	0·52	1·58	2·34	2·39	1·89
1955 =	100·0	100·0	100·0	100·0	100·0	100·0	100·0
1965 =	123·0	116·0	113·0	115·0	128·0	131·0	108·0

In 1955—1965 Poland's share in world production, computed on the basis of the 108 economic elements, increased by 23 per cent (in industry by 16 per cent, in agriculture by 28 per cent).

It should be noted, however, that the increased share of a given country in world production does not necessarily imply rapid economic development, but can, in some cases, be caused by a stagnation or regression of certain fields in world production. The reason for this need not only be economic regression, but also changing trends in the economy of certain countries. A drop in world production due to such causes is exemplified by rye production which on a world scale decrea-

tassium fertilizers, 17) phospate fertilizers, 18) cellulose, 19) sawn timber, 20) paper, 21) artificial fibres (non-cellulose), 22) cellulose artificial fibres, 23) plastics, 24) electric power, 25) sugar., 26) cigarettes, 27) beer, 28) wine, 29) margarine, 30) synthetic rubber, 31) timber.

Agriculture: — 52 elements.

Crop production: [47]; 1) wheat, 2) rye, 3) barley, 4) oats, 5) maize, 6) millet, sorgum, 7) rice, 8) pea, 9) bean, 10) lentil, 11) soybean, 12) cotton, 13) hem, fibre, 14) hem, seed, 15) repaseed, 16) sesame, 17) sunflower, 18) copra, 19) hop, 20) flax, seed, 21) flax, fibre, 22) jute, 23) tobacco, 24) sugar cane, 25) vetch, 26) sugar beet, 27) potatoes, 23) sweet potatoes, 29) onions, 30) tomatoes, 31) apples, 32) pears, 33) plums, 34) cherries, 35) vine grapes, 36) citrus fruits, 37) figues, 38) bananas, 39) olives, 40) groundnuts, 41) coffee, 42) cocoa, 43) tea, 34) rubber, 45) sisal, 46) peaches, 47) apricots.

Animal production: [53]; 1) meat, 2) milk, 3) wool, 4) eggs, 5) fishery.

sed from 37 million tons in 1955 to 35 million tons 1965 whereas in Poland during the same period it increased from 7 million tons to 8·2 million tons. A similar phenomenon can be observed in the production of oats and flax. Generally speaking, however, decreased production on a world scale occurred rarely in 1955—1965. Consequently Poland's increased share in world industrial and agricultural production resulted mainly from dynamic economic growth, more intensive in Poland than in many other countries.

The complex production index can be applied also when comparing the production potentials of various countries and of economic or political groupings. The index makes it possible to express the production of these countries in comparable parametres and to appraise them in the light of productive results, without, furthermore, taking into account the economic effects of non-productive activities, such as financial turnover, tourism, transport, brokerage transactions, etc. The complex production index, therefore, as stated above, is not a substitute for the national income index but supplements it only.

When the complex production index is used in comparing various countries, a need is felt for weighing economic elements included in the index. In certain computations, especially in relation to countries with an one-sided economic profils, their equal treatment may result in overestimating or underestimating the actual position of respective countries in the world economy. However, in relation to areas with a differentiated type of economy in the domain of extractive and manufacturing industries and agriculture such mistakes are counter-balanced to a great extent.

These difficulties could be optimally solved if weighed elements were used in calculations, i. e. if the share of respective countries in the world production of, for example, steel, electric power, cement, sulphuric acid, etc. were not computed in the same way. However, in the assessment of weight there is always a danger of subjectivity; therefore, if such a procedure is applied, it should be based on properly founded economic assumptions. Some sporadic attempts undertaken up-to-now do not yet provide any foundation for generalization. The starting point in such attempts towards weighing economic elements are the differences in the value of products. This is not an easy task. Prices oscillate not only in a given period of time (this can be eliminated to a certain extent if, for example, they are averaged over to ten years) but also in space. For many articles, agricultural in particular, it is hardly possible to fix an international price on the basis of statistics available.

Thus, the application of the complex production index based on an arithmetic, even non-weighed, seems to be justified in many cases, as this method makes it possible (only approximately but on the basis of ample material) to define and compare the production potential not only of one country at various times but also of various countries.

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DERIVATIVES OF THE TERM „CLIMATE" AND THEIR GRADATION

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In recent times, scientific literature has been expanded by the introduction of a number of new terms formed by the addition of prefixes to the word „climate", such as aero-, agro-, bio-, phyto-, micro-, macro-, etc. This gave a start to the nomenclature of specialized branches or trends in climatology concerned with agroclimate, bioclimate, etc. The two latter branches are limited to the effect of the climate upon:

— agricultural production in a wide sense, i. e. on plant life, live-stock raising, forest production, on the keeping quality of rural produce during storage and transport, on the appearance of plant diseases, etc.,

— live organisms in general, and on man's health in particular (medical bioclimatology).

In all these cases the climate is treated as an agency with a definite effect on a definite object (or assemblage of objects) or on a process (or chain or processes). These may be of interest for scientific or practical, usually economic, reasons. There are also instances when the prefixed term denotes the part played by the climate in a somewhat different way. To give an example, phytoclimate is taken to mean the climatic conditions which have developed due to the effect on definite meteorological features of some definite plant assemblage or, in other words, it is that climate which prevails within the given assemblage, like the climate of a forest, of a wheat field, etc. In a case like this the climate is in part the object exposed to the effect of the surrounding plant environment. One may say that any type of phytoclimate is intimately linked with some particular biotope. As is mostly the case in situations of this kind, these relations are reciprocal, their features are mutually contingent on each other, apart from those which are due to external factors.

In practice the climatological terms discussed above, derived from the word climate and narrowing down its general meaning to a specific sector of interest, do not introduce any serious difficulties or ambiguities.

This cannot be said of the terminology intended to associate the concept of „climate" with a definite gradation or spatial dimension of the object under discussion, such as micro-, topo-, meso-, and macroclimate. In recent biological, geophysical and geographical literature these terms have been given a wide variety of meanings, so far as the scale and type of object dealt with is concerned. Some authors associate the concept of a microclimate with the climate of an entire town, usually a large one; others use it in connection with the surroundings of a forest clearing, others again for a bird's nest. In this way the legitimate intention of putting more precision into the description of grades of climates has been frustrated.

The author has already published several papers on this subject, and this releases him from the necessity of repeating a number of details [1]. The present article gives further attempts to put in order concepts containing rather vague definitions of the spatial ranges of a climate. While his previous publications were for the most part limited to terms in common use, the author has now supplemented his terminology with additional words.

It should be mentioned that similar attempts have also been made by other authors [2], including Mörikofer. His suggestions are given in Table 1.

The German terminology given in Table 1 is by no means commonly accepted and uniformly understood, even in the German literature. Its translation — while not fully adequate — is intended to show that it would be no easy matter to introduce this kind of terminology into scientific literature on an international scale. If in addition the orders of magnitude in Table 1 are taken into account even with a considerable tolerance, it will be seen that the system is altogether too rigid and arbitrary, and as such must be rejected.

Climate is a geographical conception because it cannot exist outside the space which forms the object of geographical research; it is always located in a definite physico-geographical environment in the widest sense of this term. One may, in this case, disregard the climate on other planets or on the Moon although even for these bodies terms may

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[1] W. Okolowicz, Macro-, Meso- and Microclimate, *Przegl. geogr.*, 32 (1960), Suppl.; Der Begriff des Klimas, *Időjárás*, 65 (1961), 4. Zadania i metody współczesnej klimatologii (Wstęp), *Przegl. Zagr. Liter. Geogr.* IG PAN, 2 (1964); Klimatologia Ogólna, PWN, Warszawa 1969.

[2] J. Blüthgen, *Allgemeine Klimageographie*, Berlin 1964; S. P. Chromow, Klimat, makroklimat, klimat lokalny, mikroklimat (Polish translation), *Przegl. Zagr. Liter. Geogr.* IG PAN, 2, 1964; V. Krečmer, *Pojęcia podstawowe w klimatologii* (mezo-, makroklimat), as obove.

TABLE 1. Morikofer's concept of climate and its order of magnitude (quoted after Blüthgen, 1964)

Definition	Order of magnitude	Examples
Zonal climate (Zonenklima)	5000 km	Temperate Zone
Wide-range climate (Grossraumklima)	1000 km	Central Europe
Wide-scape climate (Grosslandschaftsklima)	100 km	Rhaetic Alps
Landscape climate (Landschaftsklima) Environmental cl. (Geländeklima)	10—20 km	Region of Davos
Local climate (Standortklima) a) of plains b) of mountains	 2000—4000 m 100—1000 m	 A wide valley Valley floor and slope
Minor area climate (Kleinklima) also climate of near-ground air layer	10—50 m	Erosive ravine
Climate of a boundary surface	cm — mm	Rock surface

be useful that are unambiguous in their application to the Earth's geographical space.

Consequently it would seem the simplest and the most logical way to define terms characterizing a gradation of the climate by connecting the individual terms with geographical concepts in their taxonomical relationship. The author has attempted this in Table 2.

The new table contains some terms suggested by Mörikofer, such as „climate of a boundary surface" and „planetary (or zonal) climate' besides suggestions made by the author in earlier publications. The term „geoclimate" has also been added. This seems to be justified by the necessity of bringing the fairly extensive series of terms to a close.

The transformation of energy, for example radiation into heat, and a number of other processes take place on the boundary surface separating the atmosphere from its substratum. This is an exceptionally variegated surface made up of minerals and organic substances, animate and inanimate, each of which has its own physical and chemical properties. In practice the study of the „climate" of the boundary surface goes

TABLE 2. Different grades of derivatives of

<table>
<tr><th rowspan="2"></th><th rowspan="2">Climate of boundary surfaces</th><th colspan="2">Microclimate</th><th rowspan="2">Topoclimate</th></tr>
<tr><th>a) of an unit surface</th><th>b) of an air layer</th></tr>
<tr><td>Gradation of range, spatial dimensions</td><td>The spatial dimensions are very small; in terms of surface they correspond to natural sizes, like the surface of a leaf, a mineral on the rock surface (measurable in mm and cm).</td><td>Basic spatial units of the natural environment, in the most part of geographical dimensions, corresponding to ecological unit environments like a tree crown, a tuft of grass, the surroundings of major boulders, stacks of hay, etc.
Note: a) does not apply to major uniform surfaces, like lakes, or the sea.</td><td>Limited to the near--ground air layer (over a uniform surface, in thicknesses of up to 2 m). Forms an integral part of an assemblage of unit microclimates. Transmits the effect of an active surface (the ground and the objects covering it) to atmospheric processes and vice versa.</td><td>Refers to elementary geographical taxonometric units which are not independent units but rather components of such units, like the climate of a lake shore, of the crest, slope or bottom of a valley, ravine or basin, or the climate of a forest meadow, an urban street, etc. or of an assemblage of very small land forms.</td></tr>
<tr><td rowspan="3">Degree to which similar physical features occur.</td><td rowspan="3">Almost universal for an indentical physico-chemical kind of surface, such as: the human skin, the surface of needles on coniferous trees, the surface of granite rock, etc.</td><td colspan="2">A high degree of universality within the boundaries of:</td><td rowspan="3">A high degree of universality for identical types of taxonomic units and their spatial situation in nature; such as the climate of slopes with a southern exposure.</td></tr>
<tr><td>similar environmental units</td><td>similar aggregates of elementary units, overlying similar substrata</td></tr>
<tr><td colspan="2">The law of analogies can be widely applied.</td></tr>
</table>

continuation on pages 82 and 84

the term "climate" and their characteristics

Mesoclimate	Macroclimate	Geoclimate	Planetary climate
Is restricted by the size of independent taxonometric objects such as: the climate of a valley, or of a group of lakes, of forests or of dune clusters, or the climate of a town.	Is confined by the extent of a geographical region or subregion or any area of a similar category which takes in a climatic region or subregion; like the climate of the Silesia — Małopolska Upland.	This term covers considerable parts of a continent or of an ocean, such as: the climate of Central Europe or the western part of North America with the adjacent ocean.	Comprises the entire surface of the Earth, or a very considerable part of it, such as the climate of the Northern Hemisphere, that of the temperate latitudes, the tropical zone, etc.
A fairly high degree as far as independent geographical units of identical type are concerned, in similar surroundings; for example, in the case of mountain valleys or of valleys incised into a plain.	On the whole limited to similar types of climate to areas situated alike with regard to land and sea in identical zones on both hemispheres.	Only with regard to certain features, when otherwise marked similarities exist in the situation as to oceans and lands and as to general relief features.	In terms of the similarity of processes occurring in both hemispheres.

continuation on pages 83 and 85

	Climate of boundary surfaces	Microclimate a) of an unit surface	Microclimate b) of an air layer	Topoclimate
Degree of permanence (transience).	Extremely variable, depending on the stability of features shown by the boundary surface and on the permanence of the surface of the given object.	Usually varies considerably; this depends on the permanence of the nature of the substratum and surroundings. It is conditioned by natural processes and by man's activities (the way in which he utilizes the ground surface) may also suffer seasonal changes (such as crop rotation in fields).		Slight transience due to relief shape but depending on the kind of ground cover, the topoclimate might undergo considerable changes, connected with structural changes of the microclimate.
Structure; relation to other categories of ranges; possibilities of subdivisions.	Elementary structure (variable from point to point). The variegated assemblage of climates of boundary surfaces constitutes one of the factors creating the microclimate (conditions of energy and humidity). Corresponds to "active surface".	The structure is polyelementary (variable from unit to unit and in time). It is connected with the higher-grade category (the topoclimate) mainly by b), i.e. the microclimate of the air layer. A subdivision is conceivable into types, depending on the character and the morphology of the nearest surroundings, the "substratum". b) Corresponds to „active layer". **Note:** above homogeneous surfaces like water basins, the microclimate a) does not occur, b) is monostructural, like a topoclimate.		Can be subdivided into separate types depending on the kind of elementary geographical unit and its structure (such as a slope climate). It can also be monostructural (on a slope of uniform structure and vegetation). Topoclimates are both component parts of, and factors affecting, the climate of higher-grade units (the mesoclimate).

continuation on page 83

Mesoclimate	Macroclimate	Geoclimate	Planetary climate
On the whole fairly permanent, with changes proceeding slowly and dependent on radical changes in geographical environment.	Variations very small dependent rather less on geographical than on geophysical factors.	Any transience in terms of geological time (changes over the centuries) depends on astrophysical and geophysical factors.	
There are many individual types of a mono- and polystructural climate, corresponding to types of geographical units; like a town's climate, the climate of a valley, etc. They all constitute components of the macroclimate.	Subdivided according to their structure into: — homogeneous (monostructural) climates conformable to the character of the mesoclimate, such as a steppe climate, — — complex (polystructural) climates which may consist of a variety of mesoclimates like: the climate of a plateau dissected by valleys or of variegated postglacial areas. The macroclimate is part of the next-higher category (the geoclimate).	Divided into large geographical units such as oceans, continents, or parts of them with individual names: for example the climate of Northwest Europe. As a rule polystructural if they include land areas.	Divided into zones, for example those of general atmospheric circulation such as the trade, zone of illumination, and others.

continuation on page 85

	Climate of boundary surfaces	Microclimate		Topoclimate
		a) of an unit surface	b) of an air layer	
Methods of research (instruments, source material).	Physical and biophysical methods, with precision instruments used exclusively.	Special methods and instruments, together with standard methods and instruments, arranged in a particular non-standard way, adopted to the object to be examined or the degree of differenciation of surroundings and substratum (usually this refers to heights of less than 2 m).		To some extent standard methods and instruments are used, arranged so as to fit the object to be examined, its structure, exposure, etc.
	Laboratory type investigations to a considerable extent.	Observations and measurements made directly in the field.	To some extent methods are common for micro- and topoclimate.	

beyond the normal domain of climatology and belongs more to molecular physics, bio- and geo-chemistry.

The terms geoclimate [3] and planetary climate refer to the climates of very large areas. The former is free from associations with definite climatic zone, and might be applied to one of the continents or a large part of it. The latter term implies connection with at least one definite zone: for example the climate of the tropical zone of the northern hemisphere or of the whole Earth.

In Table 2 the author also attempts to show how a variety of climatic features depend on scale, such as the distribution of similar physical properties, their permanence, etc. The kind of differences which appear seem to support the suggested linking of the individual climatic terms with the corresponding geographic-taxonomic units.

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[3] Here the prefix „geo-" is meant to emphasize the large size of the area (unit) under discussion, such as with terms like syncline and geosyncline in geology.

Mesoclimate	Macroclimate	Geoclimate	Planetary climate
Standard methods and instruments are used, placed according to the character of the object to be examined.	Standard instruments and methods, adapted as appropriate for use over a wide area.	Suitable use is made of available research reports (characteristics) of the more important components or groups of macroclimates.	
Meteorological data from the archives, supplemented by special field studies.		Archival material is used exclusively, studied in office and laboratory.	

GEOGRAPHIA POLONICA 16, 1969

ON THE PROBLEMATICS OF ESKERS

CECYLIA RADŁOWSKA

In the course of the last few years scientists concerned with the evolution of postglacial relief forms have started to pay more and more attention to the problems of deglaciation. In consequence explanations have been known for a long time. Recently, however, despite all the and, at the same time, the list of such forms has been supplemented. This applies to young glacial areas as well as to the areas of the older glaciations [2, 8, 10, 14, 17, 29, 34].

A fairly large volume of literature has accumulated on eskers, which have been known for a long time. Recently, however, despite all the efforts intended to illuminate the overall mechanics of deglaciation and the land forms involved, interest in eskers seems to have lessened and attention has rather been concentrated on kame problems [1, 13, 15, 18—22].

The author considers it advisable to deal with all the land forms resulting from deglaciation together, as far as is possible, because they all belong to one genetic group and to some extent all have evolutionary links in common. This procedure would avoid rigid terminological schemes and make it easier to deal with forms of more complex origin, which cannot be assigned to any of the established categories. At times the detailed examination of excavations suggests very complicated mechanics for the structure of a form, leading to reappraisals and the establishment of new types. Forms showing a variety of features, that is forms of polygenic origin, have already led to the use of many hyphenated terms in the literature, such as esker-moraines, esker-kames, esker-like, kame-like, etc. [4, 5, 26].

Geomorphological surveys carried out in the NE forefield of the Holy Cross Mountains have supplied further evidence on this subject.

West of the Vistula, in the area where this river runs through the South Polish plateaus, a fairly uniform upland is spread out on a foundation of worn-down Mesozoic rocks. It is mantled by a severely denuded cover of glacial deposits from the Riss age. The absolute altitude of this upland is nowhere more than 210 m. There are many sites where bedrock is exposed on the surface. In the walls of quarries for Upper Cretaceous „opoka rock" (a peculiar siliceous clayey limestone) and marls, frost disturbances can be observed at the top of the rock beds. Here periglacial denudation has caused an almost complete degradation of the Riss deposits and has also affected the Pre-Quaternary surface. This surface was subaerially sculptured throughout the Tertiary and subsequently first mantled by covers of glacial deposits, then exhumed and again transformed during the Interglacials and by periglacial conditions. It shears the generally monoclinal structure of the different Mesozoic series in the periphery of the Holy Cross Mountains. This is, therefore, a typical denudation plain. Fragments of the plain ressemble the stripped surface of a Paleogene planation, although in a tectonic sense the plain represents some sort of a fault trough, bounded to west and south by a flexure at the line of contact between Jurassic and Cretaceous [23]. However this fault trough is not reflected in the land relief [24]. A line of hillocks roughly 15 m high runs approximately north and south for some 8 km along a longitudinal depression in this plain. At many places quarries have uncovered the internal structure of this line of hillocks, revealing layers of large pebbles, gravels, sands and silts, cross-bedded for the most part, but in places parallel also. Local material is intermixed with northern crystalline material. Local calcareous rock predominates in the coarse fractions, while the proportion of Scandinavian crystalline rock is much smaller. The top part of the material has been disturbed by processes of frost segregation and by solifluction. Boulder clay of Riss age lies at the base of the hillocks, and sometimes higher up their slopes as well. Some patches of this boulder clay are also found on the crests of the hillocks.

This completes the general description of the situation (see Figures 3 and 4).

The line of hillocks described above is called the Tarłów Esker. This form was examined a long time ago by Łuniewski [16] and later on by Samsonowicz [31]. The Tarłów esker provides a record of deglaciation processes in the area of maximum extent of the Riss Glaciation which, by way of a Vistula lobe, invaded the Vistula valley as far as the Zawichost gap [28].

To the west the esker adjoins the Ścięgno valley which gives the impression of being a depressed furrow belonging to the esker. In its upper part this whole valley is masked by sand dunes and the form is not easily recognizable (Fig. 1); only when it reaches Tarłów does it assume the true features of a fluvial valley.

Załącznik do pracy:
„Geographia Polonica", 16
wklejka między s. 88—89

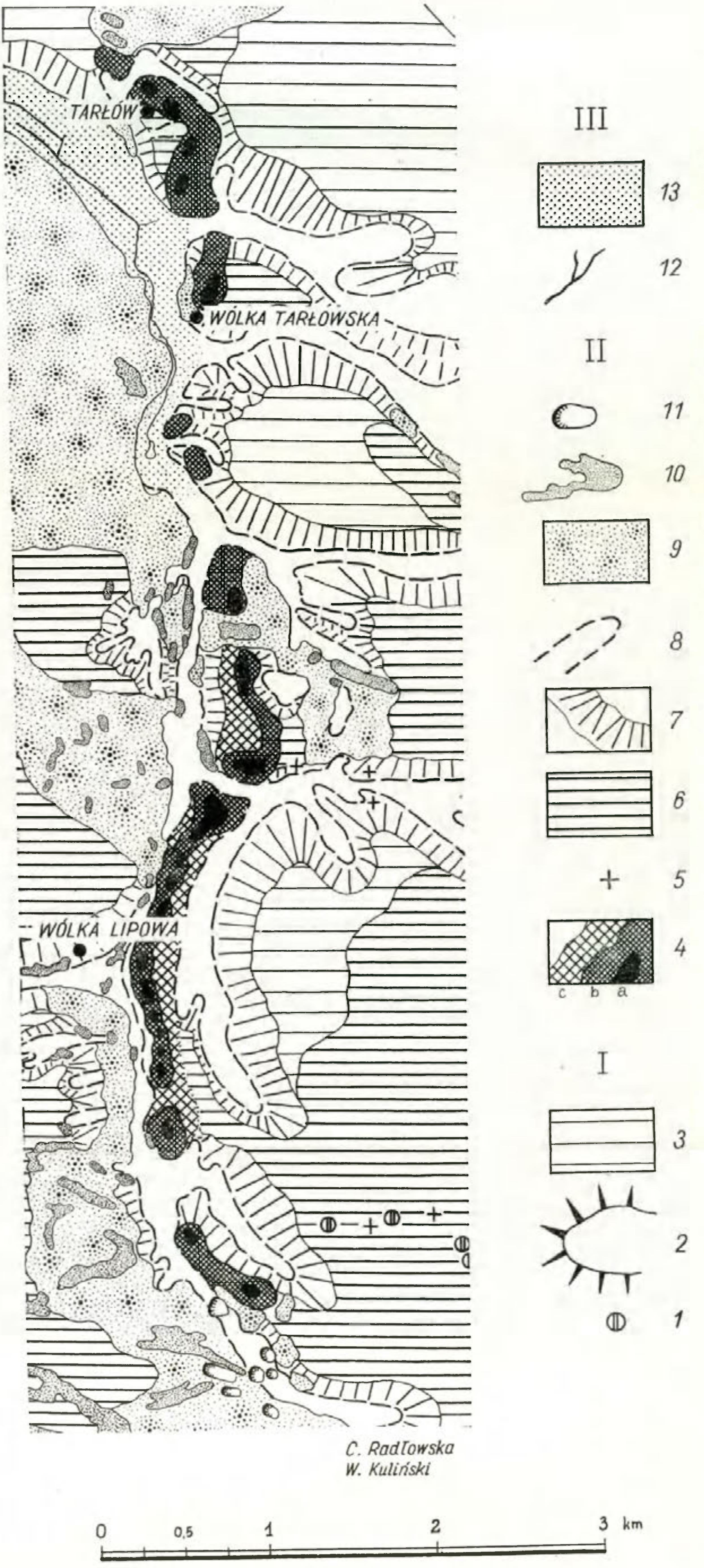


Fig. 2. Geomorphological map of the Tarłów Region

I — Forms dating from the Tertiary: 1 — karst depressions, 2 — denudation humps of basement rock; 3 — exhumed rock relief: II — Pleistocene forms; 4 — esker: a) crest parts, b) esker ridge proper, c) esker material at ridge base; 5 — erratics; 6 — denudational plain; 7 — denudational slopes; 8 — dry through-shaped valleys; 9 — sheets of wind-blown sands; 10 — dunes; 11 — deflation basins; III — Holocene forms; 12 — erosive rock incisions; 13 — flood-terrace plain

Państwowe Wydawnictwo
Naukowe, 1969 r.

Drukarnia: Pabianickie Zakłady Graficzne
Pabianice, Piotra Skargi 40
Nakład: 710 + 90

Fig. 1. View showing the western slope of the esker and the esker depression

Samsonowicz believed both the esker and the Ścięgno valley to extend along the line of some ancient valley following the longitudinal axis of the Tarłów graben [31].

The Tarłów esker is shown against the sculpture of the adjoining region on a geomorphological map (Fig. 2). The chain of esker hillocks is indeed linked with the longitudinal depression occupied by the small Ścięgno river, but this does not apply to the entire valley length. In their northern part the esker forms occur on the Cretaceous surface; further downstream they descend the rocky slopes of the Ścięgno valley, continuing in close contact with it, and only entering the depression in the southern reach of the valley, where they remain close to the base of its eastern slope.

Both the Tarłów esker and the Ścięgno valley take advantage of a wide depression carved into the rocks of the Pre-Quaternary substratum, as is clearly visible in the transverse section shown in Fig. 3. Bore holes have revealed the geological base of the esker which rests on a rock basement. At several meters' depth this shows no overdeepening underneath the esker. The „root" of the esker lies at a depth of 15 m. relative to the adjoining uplands, which are built of Cretaceous rock and are only slightly mantled by boulder clay from the Riss Glaciation. However, the esker base does not rest on the lowermost part of the depression incised into the bedrock. The axis of the depression lies west of the esker, underneath the morphological axis of the Ścięgno valley, and so conforms to the present topography. The altitudes given in this paper refer to the esker's height above the rock surface. During the inland ice recession of the Riss Glaciation this

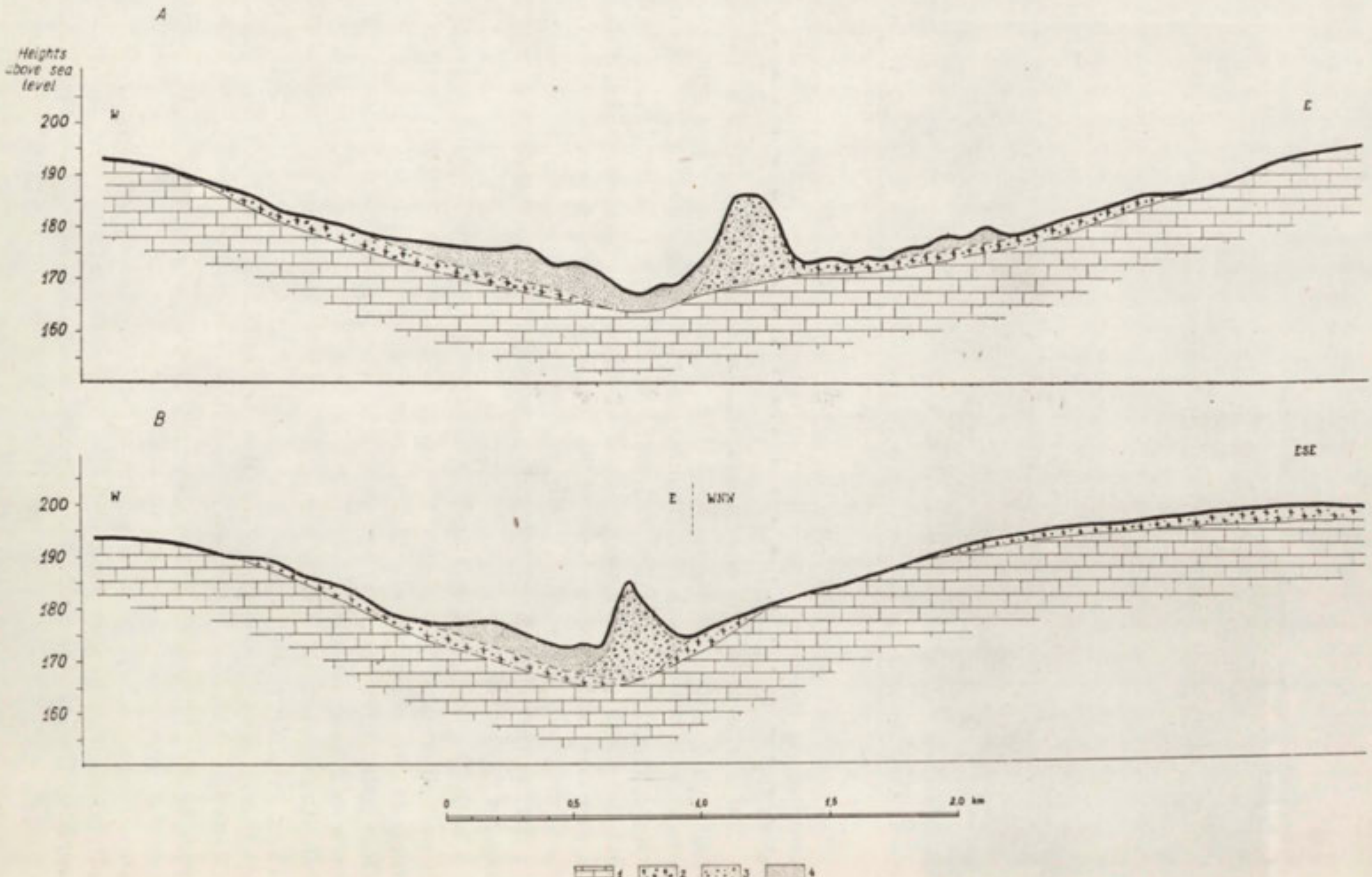


Fig. 3. Esker form against the background of the relief in the adjoining region
1 — Upper Cretaceous rocks; 2 — boulder clay; 3 — esker material; 4 — sands

region was covered by a boulder clay layer, and the differences in height above the rock surface must have been much greater [26, 27].

As far as the Tarłów esker is concerned, the denudation of the Pleistocene deposits made it relatively easy to reach the bottom of the esker material and to uncover the concave form into which it had been deposited. For this reason there is no need to discuss here the part played by meltwater in eroding the esker channel and the furrow next to the esker. It is evidently not always necessary to look for genetic explanations in the mechanical action of glacial waters [25, 32]. The study of this esker confirms the influence of the prior relief on the position, the direction and the course of the deglaciation processes which took place during the Riss Glaciation [6, 12]. It will be realised that it is much more difficult to solve a problem of this kind in young-glacial areas where the Pleistocene deposits are often very thick.

From the transverse cross-sections it can easily be seen that the crest parts of the esker hillocks (maximum height 192 m) lie below the surface of the adjoining upland, the altitude of which reaches 210 m. Thus the esker is seemingly hidden, buried in the land relief. This may also in part explain why the esker has survived till now despite all the denudation which has taken place around it. Indeed, the Tarłów esker is one of the few isolated residual forms found in the area dating from the older phase of the Riss Glaciation.

The Tarłów esker, may be looked upon as a forerunner of the relief pattern characteristic of parts of Poland further to the north, where developed forms can be found under the cover of Pleistocene deposits.

The esker under discussion follows a sinuous course, forming a chain of minor longitudinal hillocks with slightly protruding culminations. The separation into a number of individual elevations may to a large extent be regarded as a secondary feature, brought about by a number of small valleys running into the Ścięgno valley which are now dry. Only very few dissect the esker down to its base; most of them still contain esker material in their floors. This indicates that the Ścięgno valley started acting as erosive-denudative base after the esker had been formed.

A careful examination of exposures in this esker chain suggests some general reflections on the origin of eskers and their development in successive phases. Although the Tarłów esker has an internally compacted structure with coarse material at the core, the slope descending towards the Ścięgno valley shows signs of a new accumulation pattern. Different material and dividing planes, can be seen here running discordantly where they meet new series of deposits. This seems to imply a rather complex mechanism for the development of this form.

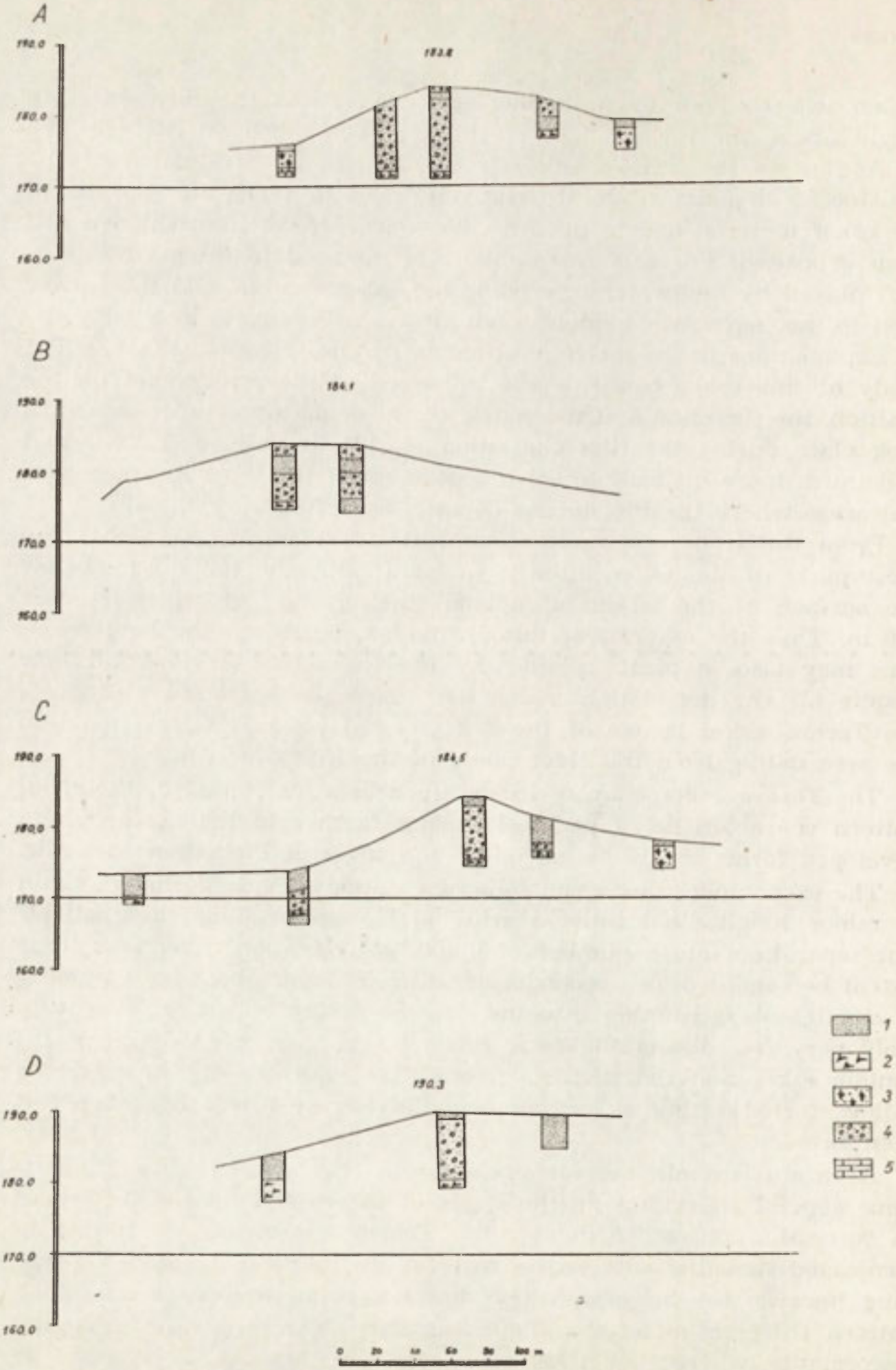


Fig. 4. Transverse sections based on drill cores
1 — sand; 2 — silt; 3 — boulder clay; 4 — gravels; 5 — limestone debris

Some information on the internal structure of the Tarłów esker is contained in the cross-sections prepared by the Cracow Geological Enterprise to determine the amount of gravel available. The sections in Figs. 4A and 4B show the structure of the central part of the esker, with a predominance of coarse material and stratification of the finer material. The following sections (Figs. 4C and 4D) lie further towards the slopes of the esker and show how the sandy-silty fraction deposits grow in thickness.

Fig. 5. Gravel and sand series in the Tarłów esker

A close study of excavated sections of the esker has revealed that even its central part contains wide differences in fractions. The coarsest gravels and pebbles lie at the bottom, overlain by bands of gravel-pebble material mixed with finer gravel and even with sand. Locally, though not everywhere, four successive series of this sort lie on top of each other (Fig. 5). This indicates, on the one hand, certain stages of evolution and, on the other, the existence of some kind of main tendency in the esker towards the deposition of the coarser material. This seems to be confirmed by a further fact: at an identical level in a given cross-section, i.e. at the same distance from the proximal side of the esker, fine material lies along the sides of the coarse material (Fig. 6). Phenomena of this kind may also be ascribed to a widening of the ice tunnel and a lateral enlargement of the esker [6, 7, 35].

Fig. 7. General nature of the complex esker form structure

Identical changes in sedimentation, i.e. the same pattern of deposit accumulation, can be traced throughout the length of the esker, while the fractions of the material gradually decrease in size towards the south.

Sedimentation is most disturbed, or least regular, in the northern part of the esker, and here the esker core contains the coarsest material. Big elongated boulders, up to 0·5 m in size, form a mass of tightly packed rocks in the esker bottom. Massive boulders of Cretaceous marls predominate, but there is also an exceptionally large share of northern rock material such as granites, porphyries, and a variety of metamorphic rock. The same sort of accumulation of big boulders can also be seen in other nearby exposures in the northern part of the esker. Towards the south the difference in size of the fractions decreases.

The series showing a parallel stratification dip several degrees towards the south. From this, and from the manner in which accumulation has proceeded, it may be concluded that this esker form was built by streams flowing from the north [9].

A further problem requiring investigation is the relation between

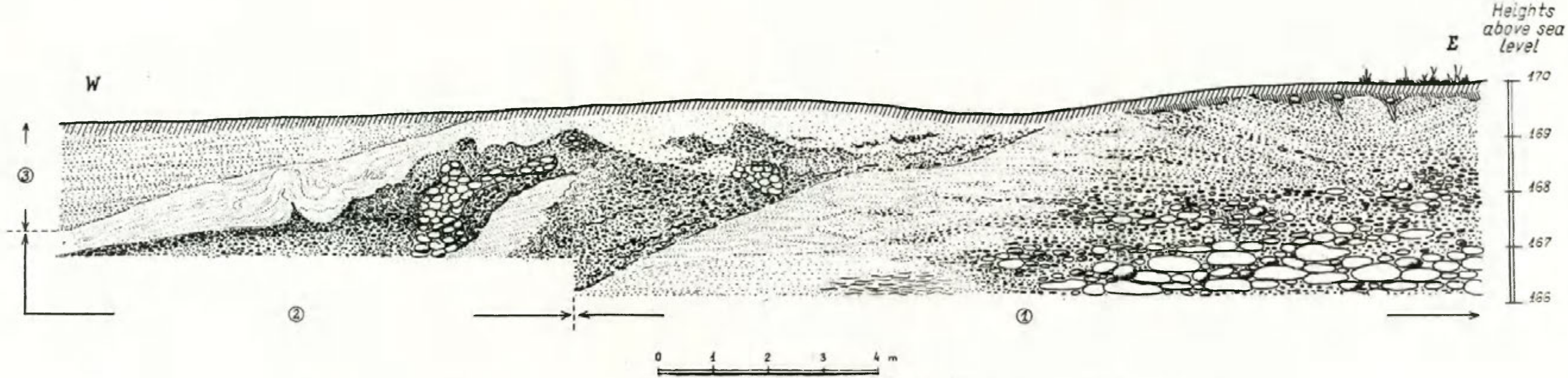


Fig. 6. Transverse section through the Tarlów esker

1 — esker material; 2 — two series of slope deposits containing patches of strongly disturbed ablation material; 3 — kame terrace sands and gravels

„Geographia Polonica", 16; wklejka między s. 94—95

Fig. 8. Mantle of boulder clay deposits on top of the esker

the boulder clay of the Riss Glaciation and the esker form. This boulder clay barely mantles the denudation plain and the esker; it can be seen on the eastern esker slope which is in virtually direct contact with the adjacent upland. Here and there the bore holes mentioned above also show the presence of this boulder clay.

In Fig. 4A a three metre layer of boulder clay, with sand in its top part, covers the slopes up to an altitude of 178 m, that is, to 5 m below the crest of the form (183·8 m). In Fig. 4C a 0·5 m sand layer can be seen covering a 3·3 m bed of brown loam lying 5·8 m below the esker top (184·5 m). Usually this loam is encountered on the eastern slope, and it is overlain locally by structureless sands which increase in thickness lower down the slope.

No boulder clay has been found in the top parts of the esker hillocks. Its prior occurrence here is marked only by patches of irregular shape; these fill pockets formed by frost disturbances in the top part of the esker material, or occur in traces as isólated boulders (Figures 7 and 8).

The position of these boulder clay remnants, as well as the fact that the structure of the glacifluvial material has not been disturbed, seems to indicate that the Tarłów esker was formed in a tunnel, probably a subglacial tunnel [3, 6, 7, 11, 25, 27].

An area of wind-blown sands with well formed dunes lies south of the esker. Most probably these sands were derived from an outwash piled up at the mouth of the esker tunnel. Their occurrence can hardly be explained otherwise, because no valley exists in the near vicinity; moreover, a fragment of this supposed outwash can be seen on the geomorphological map (Fig. 2).

Much light is shed on the problem discussed in the first part of this paper, i.e. the genetic complexity of the esker, by the exposures observed on the western slope of the esker, the side nearest the esker valley.

The author selected two of the exposures which she considers to be of particular interest. They indicate that the ice vault inside which sedimentation was taking place, failed to last until the entire esker form had attained its ultimate shape. Instead, the tunnel deteriorated gradually and irregularly. Due to this the subglacial accumulation must have been partly accompanied by the inflow of open water, and this caused the sides of the esker to acquire their uncommon features.

Fig. 6 and 7 show a transverse section of the proximal side of the esker. In the base of the esker core one sees an accumulation of massive elongated boulders of local and northern rocks. Fragments of soft Cretaceous marls of up to 0·5 m size indicate a short distance of transport.

Fig. 9. Structure of the kame terrace adjacent to the Tarłów esker

The material shows little sign of sorting. Stratified gravel beds become predominant higher up. They are cross-bedded in strongly inclined sets, seemingly sheared off in the esker top where slight traces of boulder clay may be seen. Next to these boulders and gravels lie sands with silt intercalations, in a cross-bedded or parallel-bedded pattern.

Towards the slope these beds are cut off by a plane of irregular contour, and gravels, boulders and clayey sands are dispersed along this plane. To the left of the plane is some unsorted material consisting of series of pebbles embedded in gravels and brown loamy sands; most probably they arrived here as frozen blocks. The fluidal fashion in which the diversified material has been deposited, indicates that slope processes such as solifluction and slides have been active here. This slope deposit has also been cut across by a new series of the same nature, which starts out as coarse material chaotically distributed, and gradually changes to a sandy deposit.

At a later date, a layer of evenly stratified fine gravels and sands encroached onto this cover of variegated slope deposits dipping slightly towards the south-west.

The interpretation of the esker exposure leads the author to distinguish three principal stages of deglaciation:

1. First, the esker developed in a subglacial tunnel. Next, with the

Fig. 10. Material in the core of the esker near Wólka Lipowa

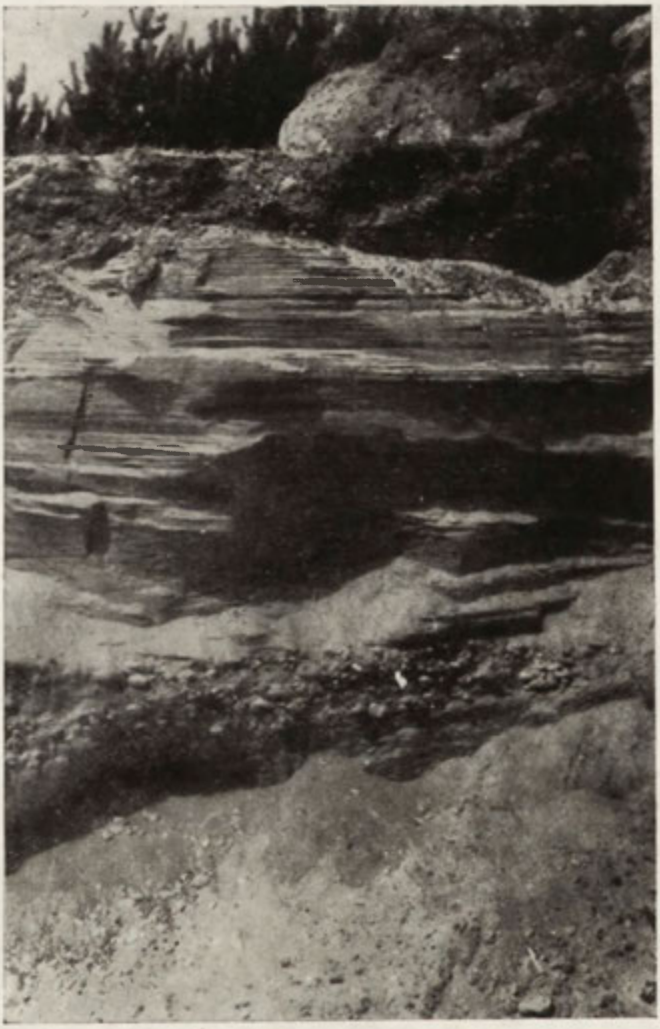


Fig. 11. Fragment of esker structure in transverse section; near Wólka Lipowa

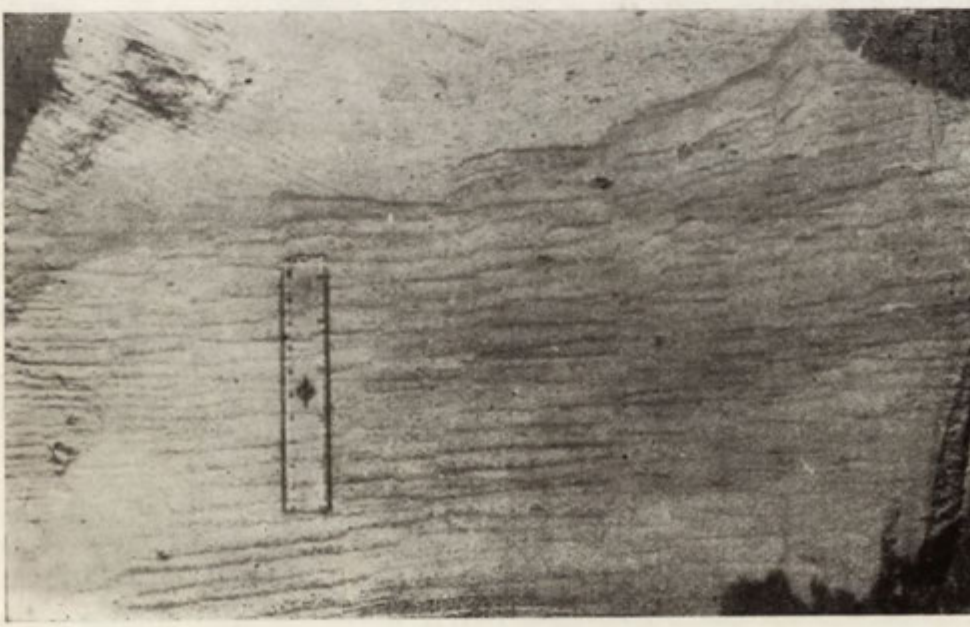
gradual decay of the covering ice sheet, the esker started to be covered by glacial till from an ablation moraine. Further deglaciation led to the exposure of the completed esker form, followed immediately by processes of settling and solifluction which affected the esker slopes. These processes occurred in two successive stages.

2. With time a free space developed between the esker and the wall of dead ice which had still survived in the adjoining depression of the rocky substratum. This crevasse provided a free passage for meltwater flow, which added a kame terrace to the esker (Fig. 9).

Fig. 12. Marginal series of esker sands, dissected by faults at the contact plane with the zone which developed with the collapse of the tunnel; near Wolka Lipowa

Fig. 13. Esker sands with minor faults near Wólka Lipowa

6*



3. After the dead ice had decayed, a valley developed adjoining the kame-esker form.

The whole series of deposits found on the western slope of the esker form clearly indicates a contact zone with the dead ice-what Flint termed an "ice-contact" [6,7].

Fig. 14 refers solely to a peripheral fragment of the western esker slope. The shape and the structure of the esker is visible in the photographs (Fig. 10—12). The stratified sands which form part of the lateral esker deposits are dissected by minor faults (Fig. 12 and 13) whose origin can easily be ascribed to the proximity of the material which was deposited as the ice tunnel, and probably its lateral walls also, melted and collapsed. Evidence for this is provided by the almost vertical arrangement of ablation deposits and the sharp downward deflection of the sand layers (Fig. 12).

Fig. 14 shows the wall of an exposure extending from the place described above towards the slope base and revealing a series of evenly bedded streaked sands adjoining the disturbed zone. Stratification in the upper part of the deposits in Fig. 5 has probably been obliterated by later ablation processes [30].

The exposure also includes a layer of boulder clay which underlies the dislocated sands in places. This boulder clay may have been melted out from the ice before the widening of the tunnel made it possible for sand to accumulate. All in all, a sequence of processes is indicated similar to that for the exposure already discussed (Fig. 6).

As shown above, the usual name "Tarłów esker" embraces two separate forms which developed one after the other during deglaciation. The ostensible geomorphological unit is the result of later denudation, which blurred the difference in the land relief between the esker and the narrow kame terrace adjacent to it. Here and there in the profile of the common slope a slight break can be observed; apart from this, the shape of the form does not betray its complicated origin. This serves as a warning that great care must be exercised when forming an opinion on the relief in areas of the older glaciations.

Similarly, it would be rash to dogmaise in the matter of the dune sands covering the western slope of the Ścięgno valley. They lay within the area of the depression containing the esker and the kame terrace (Figs. 2 and 3A). In view of the topographical position of these sands the only logical conclusion seems to be to link their origin with the kame terrace. Theoretically it seems most probable that the kame terrace developed on both sides of a dead ice lobe. It may be relevant that in this part of the Ścięgno valley, which today is drained by a small creek, big erratics are encountered on the valley floor.

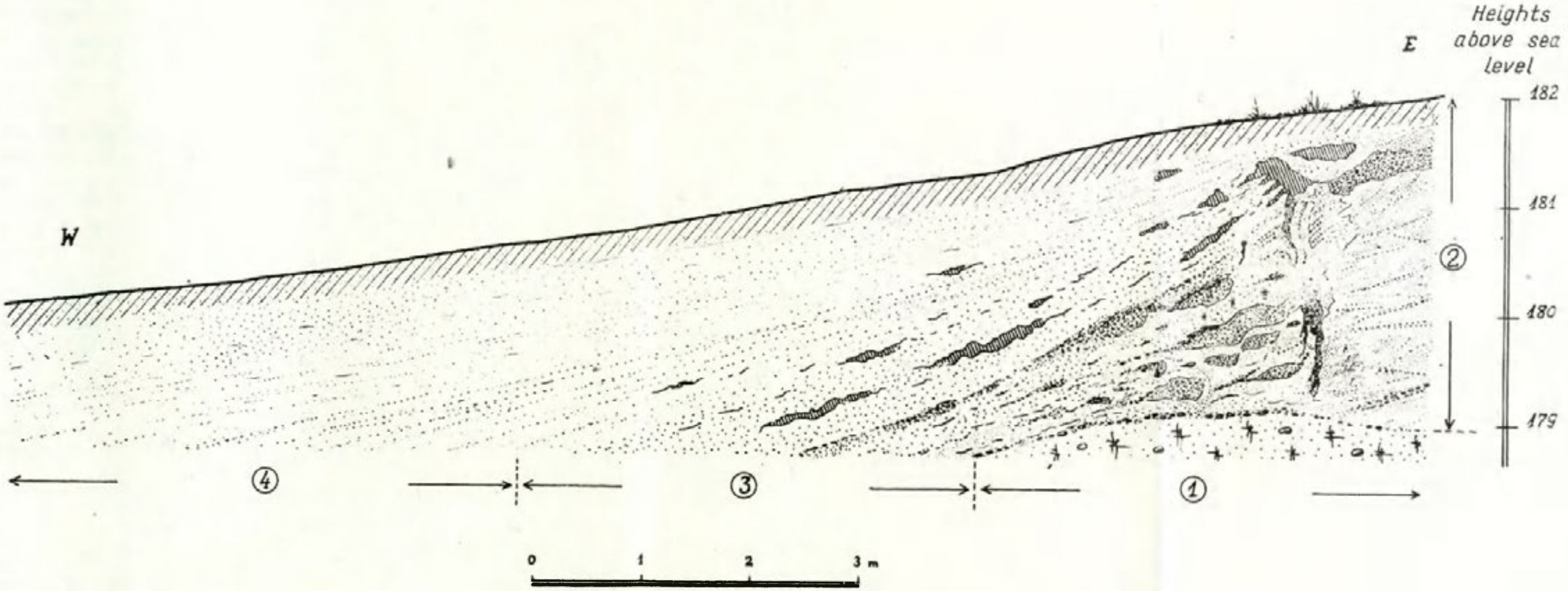


Fig. 14. Transverse section of the esker near Wólka Lipowa
1 — boulder clay; 2 — dislocated esker sands; 3 — disturbed series of ablation and slope material; 4 — kame terrace sands

Some doubts still remain as to whether the sands in question are really remnants of a remodeled kame terrace, or whether they might have been deposited at a later date. Where is one to look for the material left from the eroded upland? After all, begining with the oldest phase of the Riss Glaciation the area under discussion has undergone a long period of evolution, and what we see today is only the result of a variety of processes, some of which must have been contingent on the operation of the Ścięgno valley. Thus, while the theory should not be rejected that a kame terrace may have existed here, the question must be regarded as open and requires further detailed study.

Despite that ambiguities. the author has considered it worth while illustrating the full course of deglaciation at least provisionally, in order to create a comprehensive morphological background for the Tarłów esker, closely linked with its origin.

Deglaciation during the recession of the oldest phase of the Riss Glaciation was much diversified in space and in time. To start with, the area under consideration lay in a zone of stagnant or nearly stagnant ice, and later in a zone of dead ice. This ice rested directly on the Pre-Quaternary rock base which had been denuded of Mindel glacial covers during the Mindel-Riss Interglacial [24, 28]. It seems probable that the formation of the Tarłów esker took place during the former, and the addition of the kame terrace during the latter period.

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PROBLEMS OF THE ORIGIN OF ESKERS BASED ON THE EXAMPLES FROM CENTRAL POLAND

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The author's present paper took its origin from the exceptionally abundant material dealing with the geological structure and the lithology of eskers in Middle Poland. Her examinations took in five selected morphological forms showing distinctly features of eskers, for which the resources of available gravel and sand strata they contain have been documented within recent years. The basic documentation has been prepared by the Geological and Physiographic-Geodetic Enterprise „Geoprojekt" in Warsaw.

While compiling this paper the author studied in detail all the geological material on hand, i.e. bore hole profiles, soundings and test pits, as well as the results of laboratory examinations, with regard to the characteristic of the lithology of the deposits building these forms, in order to reconstruct the palaeogeomorphological conditions under which they must have originated [1].

[1] The source material illustrating the five eskers under discussion consists of:

256 cased-in borings with detailed profiling (including observations of groundwater horizons) from which samples were collected for laboratory examinations. Practically always these borings reached depths up to 50 m, thus pierced the full fluvioglacial series. The total length of these borings was 4060 m;

34 exposures, also profiled, from which additional laboratory samples were taken;

199 soundings and test pits, for the most part performed for verifying geological maps;

the results of laboratory examinations of 2680 samples; recorded were the following elementary data: grain size distributions for fractions: < 0.5 mm, 0.5 to 1.0 mm, 1 to 2 mm, 2 to 4 mm, 4 to 10 mm, 10 to 20 mm, 20 to 40 mm, > 40 mm; content of flushable parts (< 0.06 mm); approximate petrographical composition with four types of rock distinguished: 1) magmatic and metamorphic rocks, 2) limestones, 3) sandstones and quartzites, 4) quartz, determined separately for sands (grains below 2 mm) and for gravels; content of organic parts; SO_3 content; characteristic of selected elements of grain morphology.

All the above data were compiled by statistic methods prepared from the point of view of the dynamics of the sedimentation processes involved; calculated were a number of indices indicating the segregation of the material; drawn were geological cross-sections with due attention paid to elements of palaeogeomorphology of the investigated forms and, in some instances, palaeogeomorphological maps also. On top of this, several times field studies were undertaken in order to observe the variableness of the material uncovered in the walls of exploited pits.

For drawing ultimate conclusions the author made comprehensive use of all the elements gained from her examinations; in a number of cases some of these elements supplied her with the most essential criteria necessary for determining the origin of the given form.

An exhaustive report on this research is going to be published later in a separate paper.

GENERAL GEOMORPHOLOGICAL CHARACTERISTICS OF THE EXAMINED FORMS AND THEIR SURROUNDINGS

Scientific literature [3, 4, 6, 9] knows for a long time all the eskers taken into consideration by the author. Oldest among them are the eskers at Grójec and Zalesie, situated in the hinterland of the maximum range of the inland ice during the Warta Stage of the Middle-Polish Glaciation. In the range of this same glaciation, but already in the hinterland of the Wkra Stage, lies the Ślubowo esker. The two remaining eskers originated later, during the Last (Baltic) Glaciation: the Lewice esker, situated in the marginal zone of the Poznań Phase and the last esker at Lubasz, in the far hinterland of the Poznań Phase near the Czarnków end moraines.

All these eskers show fairly typical forms, extending several kilometers each. However, excepting the Zalesie and the Lubasz eskers, up to now for the most part they have been investigated only fragmentarily.

The eskers situated in the range of the Middle-Polish Glaciation differ essentially in their morphology from other younger eskers, belonging to the Baltic Glaciation. While the eskers dating back from the latter stages show sharply defined forms, with distinct crest lines and relatively steeply inclined slopes partly covered by tree stands, the relief of the older eskers is much gentler and rather flat; they are relatively low and some of them have their crest part covered by tilled land. Apart from the difference in age, these dissimilarities are probably caused by differences in position with regard to marginal zones. The younger eskers lie very near to end moraines, while the older eskers are situated on postglacial uplands where no end moraines have survived.

CHARACTERISTICS OF THE FLUVIOGLACIAL MATERIAL FORMING THE ESKERS

As the result of all the research mentioned the a uthor formulated, first of all, the basic assertion that the term esker denotes exclusively land forms of fluvioglacial origin built, in some of their parts at least, of gravels and sands which have been transported by subglacial waters and deposited in the marginal zone of the inland ice. Deliberately the author avoids comprehending by the term esker another type of elongated ridges whose structure reveals their having developed in cracks of decaying ice in which there may have been running a water flow of subaerial character, or where a water basin may have existed causing a tranquil ice-dammed sedimentation or where, finally, material may have been accumulating, melted out at random from the walls of the inland ice bordering the cracks.

The last-mentioned land forms should be assigned to what is called the „fissure group" (or, better still, the „decay-crack group", because one should be circumspect when using the term „fissure", confining it exclusively to inland ice cracks or crevasses resulting from the dynamics of the ice). The above land forms may also fit the term „kame ridge", provided they are built of fine-grained stratified deposits.

In recapitulation: for the most part eskers have developed under subglacial or englacial conditions, in tunnels running underneath the ice or in its interior (not contacting the rock substratum), by the action of water escaping from live inland ice.

The characteristic features of fluvioglacial material are:

1. As to the grain size of this material it would be difficult to formulate a definite theory, because it may consist of very coarse-grained as well as of very fine-grained deposits including sands. Most important, however, is the fact that all this material is very thoroughly washed and contains very little (3—4% at the most) substances apt to be flushed out and that it lacks intercalations, lenticles or tongallens of clayey or loamy material.

2. A second characteristic feature is the variableness of the material found in the different sedimentary series. This may be the result of abrupt changes in the course of sedimentation, — symptoms which do not appear in deposits of subaerial sedimentation. In vertical profiles

this variableness involves, for instance, a bed of very fine-grained material on top of a series of very coarse gravels and, higher up, without any sort of transition, again a very coarse series.

3. A further feature of fluvioglacial material is that, much like differences in grain size distribution, differences occur in petrographical composition. The latter composition is almost identical in samples taken from one series and it changes abruptly in the vertical profile as soon as the next series starts. These differences are strikingly sharp, and in an investigated profile one may observe the following distribution of rock types: magmatic and metamorphic rock — 35%, limestones — 18%, sandstones — 25%, and quartz — 22%; slightly higher or lower in the esker a total absence of limestones or sandstones may appear (magmatic and metamorphic rocks and quartz are usually represented in all the series encountered). It should also be mentioned that a change in petrographical composition may occur in material of similar grain size, showing that such changes do not depend on grain size differences. It is a common custom to consider this kind of changes in the petrographical composition with references to the mechanical composition, a basis for distinguishing what are called sedimentary series.

This topic involves a further problem: common belief holds that any increase in grain size goes parallel with an increase in the share of magmatic rock, limestones and sandstones and with a decrease in quartz content; and that, vice-versa, a fine-grained material contains a higher share of quartz at the expense of other rock types. This opinion has not been confirmed by our investigations of the petrographical composition of the fluvioglacial deposits examined. It appears that the petrographical composition of the esker material is by no means contingent on the degree how much the rocks, initially of the same kind, have been disintegrated, but rather on a divergence in the material at its source, i.e. in the inland ice from where it has been carried off by waters circulating inside the ice.

4. With an exceptionally abundant geological material available in the form of cores of bore holes sunk at intervals from 1 and 2 m up to some 50 m (in longitudinal sections up to 1000 m long), and from observations of numerous walls of gravel and sand pits in exploitation, the author attempted many a time to detect tendencies of changes in either vertical or horizontal profiles of uniform glacifluvial series. In consequence she concludes, that there is no way of setting indices by which to gain unquestionable numerical data on the direction of water flow, or on increases or decreases in the carrying capacity of the water, or on any other processes of this kind. For all this the author emphasizes that all her investigations left no doubt about it, that each time it

has been the same series which was examined all over its length in a vertical or longitudinal profile.

In recent publications dealing with eskers some authors believe the deposits of which these forms consist to have been laid down along certain lines by uniform streams of water. K. Rotnicki [5] bases his opinion on the variableness of the character of grains and of the degree of material sorting which he observed in a longitudinal section of the Bukowska-Mosina esker. In this matter observations made by the present author led her to an outright contrary conclusion: the material investigated by her discloses distinctly a variableness in grain size distribution, with indices of sorting showing both a continuity and a set direction of the processes of sedimentation, and this she considers evidence that this material has been deposited by subaerial freely flowing water, and that, therefore, this fails to be a typical fluvioglacial deposit.

After this preliminary characteristic of the material of which the fluvioglacial series of an esker consist, it should be pointed out, that nearly each of the investigated eskers contains additionally other types of deposits only indirectly connected with the esker; this kind of deposits was encountered in a variety of morphogenetic positions and may often show a diversified lithological pattern. This will be discussed in a later chapter, together with an analysis how eskers develop.

INTERNAL STRUCTURE OF ESKERS

As mentioned above in the matter of the character of the fluvioglacial material in our eskers, a number of sedimentary series can be distinguished which differ mainly by grain size and petrographical composition. Often series of this kind can be traced over wide distances, of the order of a few to a dozen or more bore holes. In this way one can define both their range of occurrence and the position of their top and base; with these data as basis one can even sketch the course of these fossil surfaces. The contour lines of this relief shows relatively flat surfaces which contain traces of erosion or, to be more exact, evorsive kettles, because here and there the axes of depressed parts show local evorsive overdeepenings, mostly seemingly small yet fairly distinct. This picture implies, that every sedimentary series took its origin from one cycle of accumulation. All the same, one must keep one's mind clear of any of the relatively well known processes of fluvial sedimentation.

The author has stated before, that fluvioglacial accumulation has proceeded in a tunnel of the marginal zone of the inland ice or, in rarer instances, in a decay crack near the tunnel outlet. In this tunnel which represents a track of passage between the live inland ice and the forefield of the ice, the rock material has been deposited in the same composition in which it had been carried off by the water stream from inside the ice. In this transition section in which hydrodynamic conditions changed abruptly, the waters aimed at getting rid as quickly as possible of the material bearing which they were unable to carry any farther. This therefore was some sort of enforced sedimentation.

Only for short sections these waters may have been erosive, attacking older sedimentary series; but this seems to have been rather rare. It rather must be assumed, that the traces of erosive action seen in the top part of older series may have originated in the final stage of water flow which accumulated the deposits of this series (older kettles), and that they have persisted only due to younger deposition. Had the older kettles been eroded by water flow or had they developed while deposits of a younger cycle of sedimentation were laid down, material of the older series would have been found mixed with that of younger series, and transition beds would have been found in the petrographical composition of the deposits, of an intermediate character between the older and the younger series; however, nowhere a mixture of this kind has been observed. All boundaries between the sedimentary series are sharply drawn.

This suggests an additional conclusion: there must have been some sort of short-lived breaks between successive processes of sedimentation.

Every fluvioglacial series took its origin during one definite period, due to the action of waters flowing from one definite direction whence they carried off a uniform rock material. The differences in composition observed in each successive series suggest a change in direction from which the waters were supplying some specific type of material. The true cause for this kind of conditions may have been some changes in the interior hydrographical system within the inland ice — changes by which at different periods different water streams became active, differing in carrying capacity and transporting material from different parts of the inland ice, and causing a different petrographical composition and a different grain size distribution of the deposits. The mutual position of the fluvioglacial series in an esker will be the topic of the next chapter.

It has been said before that the principal geological components forming an esker are fluvioglacial gravels and sands. Over and above these components, in land forms of this type there may also be encountered deposits genetically altogether different, such as ice-dammed silt and mud sheets and gravel-sand series containing xenoliths, or intercalated with layers of boulder clay and silty or muddy deposits. In one instance (Grójec) the author found a layer, several meters thick, of muds from a limnoglacial sedimentation; this layer underlies fluvioglacial deposits which in turn lie, parallel with these deposits, on a boulder clay base which here has assumed the shape of an evorsive channel. Another esker (Zalesie) contains very fine-grained sands intercalated with mud sheets, deposited in a river-type valley depression which must have been formed directly after fluvioglacial depositing had ended, but prior to the ultimate formation of this esker — a detail which will be discussed somewhat later.

Further, very often gravel-sand series can be observed with an admixture of boulder clay or silts; these deposits seen in upper parts of eskers are of an entirely different origin than the fluvioglacial deposits of the given esker.

In eskers occur also frequently layers of boulder clay, sometimes almost continuous up to several meters thick; they lie in the bottom part of the eskers, relatively deep, and from them the main phase of evolution of these land forms can often be dated.

Summing up this brief introduction one apprehends, that in the examined eskers a wide variety of genetically different types of deposits may be seen; however, it seems that the way how they originated is relatively logical, and that it can be explained by the successive processes involved in the formation of an esker form.

BASIC PHASES OF ESKER FORMATION AND PROCESSES ASSOCIATED WITH IT

1. The first problem to be dealt with is the origin and the development of the esker base. It was found in three instances (Grójec, Zalesie and Ślubowo) that this base consists of boulder clay in which an evorsive channel up to 30 m deep is incised (with regard to the boulder clay surface next to the channel where no evorsion had occurred), the channel shows overdeepenings, a typical feature of this type of forms, with relative depths sometimes as much as 10 m. The channels run in approximately the same track as today's crest line of the esker, but there also occur deviations of several hundred meters from this track, especially where eskers are more intricate in structure.

The evorsive channels are land forms which have developed under subglacial conditions inside the live inland ice, and they are often of considerable lengths. It is believed that this stage of relief evolution preceded the real esker formation and that it took place in a relatively compact and thick inland ice which at that time contained but few minor cracks and little water flow. This must have been, therefore, an area of a live inland ice whose marginal part ran some tens of kilometers farther south and which contained a well developed and relatievly stable network of main subglacial streams. The term: network of streams is important insofar as it seems, that it was mostly by these streams that transportation of the rock material proceeded, combined with an erosion of the base and the slope of these stream channels; even so, during this initial period and inside this flow track no true fluvioglacial sedimentation was taking place.

In these reflections attention should be given to the wide differences in time in which the different elements of the seemingly homogeneous geomorphological land form represented by an esker came into existence, and this is why one must be careful in deciding which section of the length of a land form is the object of discussion. In the case of eskers, one can envisage the processes involved in their formation in either a horizontal aspect — in their longitudinal profile — and this will picture all the heterogeneous processes active at different points at an identical time; or one can look upon these processes in a vertical aspect by which one observes in one vertical profile processes which occurred in different times. In view of the character of the material dealt with. more practical is the second aspect, supplemented where necessary by the first-mentioned one.

2. In Item 1 the author discusses the processes which led to the evolution of the base underlying the fluvioglacial series of an esker. Obviously the formation of a channel may end the entire process and the result would be merely the new channel; but things may turn out differently when at the same place the action of flowing water starts anew. To start with, one must take notice that by now the most forceful part of the group of processes is over; all that follows happens under altered hydrodynamic conditions. Meanwhile an intensive deglaciation has set in and, in the place of evorsive channels, subglacial tunnels develop at various depths, in which processes of sedimentation begin to take place.

Depending on the diverse conditions affecting the character of given parts of the inland ice and its substratum, further evolution of the new forms may proceed in quite different ways. In consequence there may have developed residual esker forms on the channel floor, or gravelly fluvioglacial terraces of various types, kame terraces, channel kames, or some other forms which originated along lines of ice cracks. Data of interest on this subject were reported in a paper published by S. Skompski and W. Slowański [7]. It also may happen that a more complicated picture is obtained which contains in fossil form some of the elements mentioned above.

However, it should be emphasized here that sedimentation does not necessarily follow erosive processes immediately; in fact, it seems probable that in-between there occurred relatively long breaks expressed, for instance, by deposits of tranquil water which were accumulating in the subglacial channel. It would be difficult to meditate what might have caused the change in accumulation processes, but they may have been brought about by some minor climatic oscillations or simply by changes in the subglacial hydrographical network, which for a certain time may have obstructed the water flow through a part of the channel.

The fact is, that on the bottom of the channel a series of silty deposits several meters thick has accumulated, of which the surface had the character of a kame terrace or simply of an ice-dammed plain, with a relatively even suface. Even so, this arrangement has been encountered in one case only, at Grójec.

3. The next stage is the real fluvioglacial sedimentation. It is evidence that farther north the water flow within the inland ice has increased again and that in the old evorsive channel water has appeared again; but this time this flow did not erode the base any more and instead it only deposited or, rather, precipitated the material it had brought in from its hinterland. Somewhere farther north, of course, at the same time a younger section of the same channel was developing.

The material which the water dropped in the ice tunnel, arrived in certain successive lots and its sedimentation took place rapidly. Under present-day conditions this process might be perhaps compared, as to the rapidity how it took place, with some rock fall or a mountain slide; in both cases, for all differences in morphological conditions, the accumulation of the new deposit was caused by a complete disturbance of the balance of the environment. The water streams which so far were running under pressure in specific hydrodynamic conditions, suddenly passed on into the open, although still encased within ice walls; this open space was completely inert with regard to the passing stream. These sedimentary cataclysms, many times repeated, may have been of a diversified character, and they must have been distributed at random in given regions.

The different sedimentary series were apt to build individual elevated forms and in this way may appear to be slightly interdented with each other, or they may overlie each other. Three types of different series are the most that have been discovered in one profile (at Zalesie and Grójec). However, the available source material rather shows that for the most part the sedimentary series followed one after the other, only slightly superimposed upon each other. At first sight it might seem that it is this kind of sedimentary series which produce separate raised sections of eskers — those typical swellings in the longitudinal crest line which are observed so often. However, this is rarely the case: the mutual arrangement of the individual series may at times produce something like successive hillocks following each other, but in most cases these are fossil forms invisible on the surface, and presumably elements of much larger size that the hillocks in today's land relief. The thickness of the fluvioglacial deposits measured in the vertical profile of an esker averages 20 to 30 m, and their top strata lie mostly at the same altitude above sea level as the land surrounding the esker. This, therefore, is a series which rarely can be seen in exposures, excepting occasions when a deposit is being exploited very intensively and deep pits have been dug into the esker.

4. Following the phases of fluvioglacial sedimentation, further deposits can frequently be observed which are evidence of a continuous flow of waters which bear the character of streams carrying sandy, less often gravelly material. These younger deposits are those next accumulating in the subglacial channel; by this time much of the ice surrounding the tunnel had melted and the dimensions of the tunnel had grown considerably. At times the water flow in the tunnel did erode; mostly, however, it was not the fluvioglacial deposits that were affected by this eroding but rather the contact zone between these deposits and the ice walls. Such incisions are often fairly deep, and they are filled with fine-grained material, at times containing even mud intercalations — evidence of a tranquil water flow with short-lived periods of stagnation. The channel valleys thus created were entirely filled with these later deposits which often extended beyond these valleys, occupying not only all of the ice tunnel but covering the fluvioglacial deposits as well. In the axis of the channel these deposits reached thicknesses up to 15 m, and in the open up to 8 m. For all this it must be kept in mind, that a sedimentation as described here does not appear in all eskers, only in those of a more complicated geological structure.

5. Succeeding the period of tranquil water flow in the tunnel there set in a radical change in the conditions of sedimentation. The

ceiling which up to then had spanned the tunnel, collapsed and this may have occurred by and by, at different time for different tunnel sections; but the effect was, that on top of the deposits so far described, a distinctly noticeable mantle of boulder clay was laid down which forms a particularly heave cover on both sides of the esker. In some of the eskers this boulder clay is two or more meters thick, in others the result was an intrusion of loamy material into the sand-gravel series, or intercalations or balls of boulder clay material.

Most important is, however, that the last-named loamy series separates indisputably the underlying fluvioglacial and fluvial deposits from deposits of an entirely different composition and sorting and a different grade of contamination with loamy material.

6. The deposits of the youngest series are already part of the facies of the fissure, or rather decay-crack, deposits which in a relatively chaotic way accumulated in the cavity formed by the collapsed tunnel roof. These deposits consist of coarse gravels including large boulders, and relatively poorly washed sands containing intercalations or admixtures, up to 15 percent or more, of silty parts. As a rule these deposits are fairly well stratified into laminae, but these laminae contain well mixed grains of different size. Each lamina, several centimeters thick, represents probably the deposit of one separate microcycle of sedimentation; this process must have taken place under the action of waters which carried the material for short distances only and failed therefore to sort it thoroughly.

Also found in this type of deposits are clayey and clayey-muddy layers — evidence of short-lived stoppages of water flow; this may have been due to either a temporary period of lessened melting of the ice walls, or to changes in the course of the water streams. Also seen here and there are sandy layers, but these are of rather local occurrence.

Of course it may also happen that in some eskers among the different series of sedimentation certain types of deposits predominate. Differences of this kind can even be observed in sections of a single esker — a feature readily understood considering this type of sedimentation.

Under extreme conditions one may encounter a uniform sand-gravel series laid down throughout the full length of the esker, in the form of a fluvial deposit which was brought in by a stream of waters issuing from the marginal zone of the inland ice. On the other hand one can hardly imagine a reverse pattern in which the waters depositing this type of material took the direction from the forefield towards the ice margin; yet, an opinion like this can be found in one of the recent papers dealing with the origin of the Lubasz esker [6]. A situation of this kind could probably be endorsed only if evidences were presented, that the forefield of the ice margin contained a relatively highly elevated mass of ice (perhaps an old buried glacier snout?) from which meltwater might have run down towards the inland ice margin. This sort of reasoning, however, seems to the present author to be too theoretical to be acceptable.

There remains to be considered one further question which seems rather important. As a rule the series of deposits discussed in Item 6 constitute the crest part of eskers, and this is why in this crest these younger deposits are usually uncovered in even fairly deep exploitation pits. And because frequently these deposits are as much as 15 m high, they may even represent the entire esker height visible in the land relief. This is why in investigations of the material uncovered in pits one must keep in mind, that all the deposits in sight may belong to the younger series only, which are but loosely connected with the actual esker. Thus, prior to detailed lithological examinations one must examine all available evidence revealing the geological structure of the esker, — and this should be done, wherever possible, to the very base underlying the fluvioglacial deposits.

All the information presented above refers to land forms which in the author's opinion fully deserve to be called eskers, i.e. which in their basic part consist of fluvioglacial material.

Nevertheless, sometimes encountered are transition forms which were produced by glacial waters, but where conditions were different. For instance, at Lewice can be seen the morphological form of a typical esker which has developed as follows: the marginal zone of the inland ice contained a decay-crack in a relatively compact mass of dead ice; along this crack ran glacial waters in a strong current, carrying enormous quantities of sand and gravel material. This material was deposited in the crack in the shape of a high ridge which in the ice forefield ended in a well developed outwash cone. Fluvioglacial deposition took place in this crack also, but its character changes distinctly in a southward direction: farther north one observes sand and gravel series rather typical of subglacial eskers, while farther south this sedimentation assumes the features of fluvial deposits. Here several cycles of accumulation have followed each other, beginning with very coarse-grained material which upwards shows a steady decrease in grain size until it turns into fine-grained sand, — and this again is followed by the coarse-grained material of the next cycle. This pattern in the arrangement of deposits has not been observed in any of the eskers previously described, and this is why the Lewice esker has been discussed separately. Further, here an erosive surface is missing in the esker base, and the fluvioglacial series lies here undisturbed on a very thick (10 m) layer of fine-grained sands. Also lacking are loamy deposits which would have been evidence of the subglacial formation of this esker; on the other hand, the entire fluvioglacial series contains enormous boulders of more than 1 m size which most probably have tumbled down the ice walls bordering the crack. Inasmuch as the material in this esker is for the most part fine-grained, one can hardly imagine that rock fragments of this size could have been transported by the same glacial waters. For all these essential differences the author is inclined to assign this land form to eskers, not subglacial but rather decay-crack (or fissure) eskers, because in this esker the most important feature is maintained, it consists of fluvioglacial well washed deposits with a good sorting of their grain size.

On top of this it should be stressed, that at Lewice is known the geological structure of only the southern end of the esker whose total length is several kilometers. Hence the described structure may be limited to the southern end of this esker while the whole of it may be of subglacial origin; however, further geological studies are impossible in this region, because practically all the material of this esker has already been exploited.

There exists a further type of polygenetic eskers which in their total lengths consist of sections of vastly different origin. The Slubowo esker is very long, and a section a few kilometers long has been thoroughly investigated. The northern section of this esker, its youngest fragment, shows a typical fluvioglacial structure while somewhat farther south a length of some 900 m seems to have been produced by glacitectonic processes. Here one observes strongly disturbed sands, boulder clay, silts and gravels in quantities proportional to these four components. All the evidence collected so far seems to indicate that no fluvioglacial material underlies these disturbed deposits, so that in this section the esker may be of an entirely different origin. An explanation may be seen in the geological structure of the land surrounding this esker and underlying the deposits of the last inland ice that has covered this region; these deposits consist of silts of an ice-dammed type in a fairly thick layer, and this may have contributed to an uneven settling of various parts of the inland ice on both sides of the decay-crack. This, therefore, may be a form developed, due to deep-seated gravitational dislocations, built on by a relatively thin sedimentation of decay-crack type. On the other hand, in the northern extension of the crack a regular fluvioglacial type of esker has developed, preceded by a very powerful evorsion; even so, here sedimentation took place in the open decay-crack not in a subglacial tunnel, because on top of the fluvioglacial deposits no traces can be found of a collapsed tunnel roof in the shape of loamy deposits, as has been found at Lewice.

CONCLUSIONS

With the studies heretofore made as the basis, the author asserts:

1. The eskers of Central Poland are land forms developed by sedimentation of rock material brought in during deglaciation by waters arriving from live inland ice; for the most part they were formed in the marginal zone of the inland ice, especially that part of it that underwent frontal recession.

2. The eskers are of polygenetic origin; their evolution and the changes of the sedimentary environment were contingent upon the relief forms of the substratum, the local character of the inland ice (its form, its type of deglaciation and, in consequence, the forms which the surroundings of the esker assumed), and upon the further history of the region which may have transformed the original esker form in an essential way.

3. The formation of an esker may have been preceeded by subglacial evorsion.

4. The fluvioglacial accumulation of the esker core took place in an ice tunnel, underneath the ice or inside its upper part (only exceptionally on its surface) at the outlet of subglacial waters, more rarely in open decay-cracks of the ice.

5. Well developed larger eskers have a mantle of decay (fissure) deposits which have accumulated rather chaotically in an open intraglacial depression. The deposits forming the esker mantle are very thick; their thickness is often as much as the height of the form visible above the surface of the surrounding land.

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DÉGLACIATION ZONALE — LA DÉGLACIATION NORMALE DES PAYS BAS (EXPLIQUÉE SUR L'EXEMPLE DE LA DÉGLACIATION DE LA PLAINE DE LA GRANDE POLOGNE (WIELKOPOLSKA))

TADEUSZ BARTKOWSKI

I

L'image de la déglaciation des pays bas, acceptée et soutenue généralement par les glaciologistes s'appuie sur l'analogie du processus de la régression de l'inlandsis pléistocène avec la régression des glaciers contemporains. Cette analogie est basée sur la loi d'actualisme géologique. C'est une base cependant illusoire car, bien que la loi d'actualisme géologique implique la constance des lois de la nature, elle ne garantit point la constance des conditions dans lesquelles ces lois peuvent s'actualiser.

Actuellement nous ne connaissons pas d'inlandsis, qui se terminerait sur le territoire des pays bas comme en fût le cas pendant les glaciations pléistocènes sur les vastes territoires des pays bas de l'Eurasie et de l'Amérique du Nord. Les inlandsis polaires contemporains se terminent presque sur toute leur largeur soit dans la mer, soit tout près de rivage. Dans ce dernier cas ils ont soit à forcer les chaînes de montagnes littorales, soit à se verser dans la mer par l'intermédiaire des vallées de fjords et c'est à cause de cette circonstance là qu'ils „se comportent" comme des glaciers montagneux. Les glaciers montagneux en revanche, grâce à une proximité immédiate de la zone d'alimentation à la zone d'ablation réagissent très vite à toutes, même minimes, variations du climat et subissent en outre, les influences locales du substratum glaciaire (p. ex. la différenciation de l'insolation des parois de la vallée, l'existence des „seuils" dans le fond bas de la vallée etc.). Ainsi pendant que certains glaciers avancent, les autres peuvent reculer (peuvent alors „osciller"), ou même stationner. C'est avec des glaciers montagneux qu'est liée (et elle en dérive) la conception de la régression frontale sous forme de retraite du glacier possédant un front distinct, délaissant le substratum libre de la glace, ce qui est causé par l'écoulement très intense des eaux de fonte le long de la vallée s'abaissant conséquemment en aval.

Cette image de la déglaciation ne peut être cependant transférée sur l'image de la régression des inlandsis pléistocènes -des calottes glaciaires pléistocènes. Ici le territoire d'ablation, situé sur le bord de l'inlandsis a été distant tu territoire d'alimentation, c'est à dire du centre de l'inlandsis et de l'extrusion de la glace, de quelques centaines et même de quelques miliers de kilomètres, et ainsi le bord de l'inlandsis pouvait réagir aux impulses venant de ce centre avec un retard oscillant entre quelques centaines jusqu'à quelques miliers d'années. Sur le bord de l'inlandsis aboutissant à une plaine, on n'observait pas d'influences importantes du substratum glaciaire ou de son avant-pays (justement parce que c'était une plaine et l'écoulement des eaux de fonte n'était pas facilité par l'existence d'une inclinaison longitudinale en aval du front du glacier).

C'est bien à cause de ces circonstances que l'action du facteur commun pour la déglaciation de ces deux types de glaciers- de l'ablation- nous apparait différenciée précisément d'après le principe de la vitesse de la réaction. Vu que l'action d'ablation est surtout superficiaire (d'après H. W. Ahlman [1] seulement 1% de la perte de la masse du glacier a lieu au front du glacier), c'est seulement aux glaciers montagneux qu'on peut s'attendre à ce que la régression du glacier se fera remarquer par la formation d'un front (d'une paroi abrupte) du glacier et que cette paroi „se retirera". Cela est causé par le fait, qu'un glacier montagneux sous l'influence d'une très grande inclinaison du profil longitudinal du substratum rocheux du glacier sur une distance courte seulement de quelques kilomètres et d'une grande altitude (où a lieu son alimentation) s'étend jusqu'à une position basse, où l'intensité d'ablation devient de plus en plus grande à mesure que le glacier s'avance vers les parties basses plus chaudes, de la vallée.

Contrairement à cela, sur le bord de l'inlandsis, qui se termine sur le pays bas, la régression du front de l'inlandsis n'est pas accélérée par la différenciation verticale du substratum de ce front ou du bord de l'inlandsis (elle est minime en comparaison avec la masse totale de la glace sur le bord de l'inlandsis) puisque, comme on l'a remarqué déjà plus haut, ce bord de l'inlandsis se trouve sur le territoire des pays bas, où il n'y a pas de grandes différences d'altitude — l'activité d'ablation n'est visible que dans l'amincissement zonal du bord de l'inlandsis et non dans la formation d'une paroi abrupte du front de l'inlandsis. Comme l'ont montré les observations faites sur les inlandsis polaires contemporains les parois abruptes de la glace sont rencontrées soit sur le bord de l'inlandsis débouchant sur la mer (sur l'océan) comme résultat du détachement des „icebergs", soit dans des lieux, où le découlement des eaux de fonte est facilité et- eo ipso-où le transport du matériel délaissé par la glace est facilité lui aussi. Ces conditions se rencontraient rarement sur le territoire des pays bas où on rencontrait l'inclinaison du terrain contraire à l'inclinaison de la surface de l'inlandsis.

Dans quelques cas particuliers seulement- quand la différenciation du relief du substratum de l'inlandsis sur le territoire des pays bas atteignait des mesures bien grandes (dans des grandes vallées fossiles du substratum) l'ablation se reflétait dans l'amincissement du bord de l'inlandsis non pas zonal mais aréal. Dans ce cas se formaient de grandes "pièces" de glace passive ou morte, qui possédaient la forme et l'étendue dépendant immédiatement du relief du substratum. Il est évident, que ce processus avait lieu seulement dans la dernière et finale étape de l'action d'ablation, quand la glace devenait si mince, que les influences locales du relief du substratum, vu la masse déjà petite de glace, pouvaient se faire sentir. De telle façon la déglaciation zonale pouvait se changer on déglaciation aréale.

Un cas particulier d'une telle déglaciation représente la déglaciation de ces parties de l'avant-pays de l'inlandsis, où il aboutissait à une chaîne de montagnes. Dans ce cas là l'inlandsis avançait au moyen de petites „langues glaciaires" qui s'introduisaient dans les vallées disséquant les montagnes. Ces „langues" ne descendaient pas cependant en aval de la vallée, comme cela a bien lieu dans le cas des glaciers montagneux, mais au contraire, la surface des glaciers, en se gonflant de plus en plus, s'élevait en amont des vallées et à cause de cela le front du glacier se trouvait dans les conditions climatiques de plus en plus sévères. Cette circonstance favorisait une persistance prolongée de la glace sur ces lieux en rendant sa fonte difficile. Ce processus facilitait le démembrement du bord de l'inlandsis en forme de pièces isolées de glace morte. Un tel exemple de la déglaciation a été décrit du territoire des Monts Sudety par A. Jahn [20].

Il est facile à voir que la déglaciation dépend aussi d'autres facteurs, p. ex. de la facilité d'écoulement des eaux de fonte et du transport en dehors du bord de l'inlandsis des matériaux morainiques (dont on a parlé plus haut), ainsi que de la quantité du matériel morainique apporté au bord de l'inlandsis (comp. R. F. Flint [14]) par la glace. Néanmoins il faut considérer l'ablation comme un facteur principal de la déglaciation.

L'ablation constitue bien un des deux éléments de l'équation du „bilan de la calotte glaciaire": afflux de la glace (rapport) et sa disparition (dépense = ablation). En concevant le problème de la déglaciation en des termes du bilan de la calotte glaciaire- ce qui nous parait le plus juste- nous pouvons venir à une conclusion que l'acceptation de la formation du bord de l'inlandsis, non pas en forme d'une paroi abrupte (d'un front distinct), mais en forme d'une bande (d'une zone), nous apparait comme l'unique forme de l'apparence du bord de l'inlandsis „au moment du bilan d'équilibre". C'est précisément au moment du stationnement du bord de l'inlandsis que s'y déroule la „lutte" entre l'afflux de la glace et l'ablation et puisque l'ablation pendant le stationnement du bord de l'inlandsis sur le territoire du pays bas peut agir seulement zonalement, l'expression de ce stationnement doit etre inévitablement aussi une zone et non pas un front distinct (abrupt) de l'inlandsis (L'ablation agit aussi zonalement sur des glaciers montagneux, mais ici il y a en outre les „mouvements" du front de la langue glaciaire). Quand l'afflux des masses glaciaires a vaincu, la zone d'ablation devient plus étroite ou même disparaît complètement (dans ce cas le bord de l'inlandsis est bien abrupt), mais de cette phase de l'avance on ne rencontre pas d'autres formes du relief que les „moraines d'extorsion" (qui sont formées, selon l'auteur bien dans la zone marginale de l'inlandsis, mais encore sous la glace — pas à son extérieur). Tout ce qui nous reste jusqu'aux temps contemporains des autres formes, délaissées par le glacier ce sont les formes des phases du stationnement ou de la régression (déglaciation). Ces formes naissent toujours avec le concours plus ou moins prononcé de la glace passive (ablation) ou morte (phase finale d'ablation).

Quand le bord de l'inlandsis se trouve dans le bilan d'équilibre il n'y a pas encore de déglaciation parce qu'il n'y a pas encore de disparition de la surface couverte par la glace (le sens précis du terme déglaciation), mais il y a une disparition constante des masses glaciaires, ce qui entrave l'épanchement de l'inlandsis- la glaciation. Dans cette période, à cause d'une très ablation la glace devient passive- inactive, et puis „morte", en forme d'une bande, d'une zone, et la zone du bilan d'équilibre „saute" au moyen d'un certain „paroxisme" sur une position nouvelle, plus proche déjà du centre de la glaciation.

II

Une telle notion de la déglaciation n'est point quelque chose de nouveau, elle est acceptée généralement (voir K. Bülow [13] ou R. Galon [16]). K. Bülow écrit (op. cit. p. 282 — traduction libre): „Nous aurions alors en Allemagne du Nord non pas une régression rythmique et constante du bord de la glace, mais un détachement (Abspaltung) graduel de zones bordières mortes, dont l'existence entravait l'exportation du matériel morainique et de telle façon- entre autres- a causé l'accumulation de chaînes de moraines frontales". Comme on voit, ce detachement (Abspaltung) de zones bordières mortes de l'inlandsis décrit par K. Bülow c'est précisément la déglaciation aréale dont il est- entre autres- question. R. Galon cependant, tout en partageant ce point de vue [16, 19] traite un tel mécanisme de la déglaciation comme un cas particulier, comme une déviation de la déglaciation frontale, considérée alors par lui comme „normale" (voir aussi R. Galon [15, 17, 18]). R. Galon est bien d'avis qu'il existe, outre la déglaciation zonale aussi une déglaciation aréale mais, comme on en peut juger des cartes du répartissement des moraines frontales, considérées par lui (R. Galon [19] p. 125) comme les plus typiques (donc „normales" — remarque de l'auteur) formes marginales (moraines d'accumulation, de récession ou de poussée- d'oscillation) il accepte l'existence de nombreuses dites „oscillations" du front de l'inlandsis. Ces oscillations apparaissent d'après lui- quand l'inlandsis, après avoir délaissé en un certain moment la moraine frontale ou le sandre, s'est retiré sur une distance non précisée et ensuite avança de nouveau, poussant devant lui les dépôts délaissées auparavant. De telle manière une déglaciation normale, dans la conception de R. Galon [19] ne se fait pas au moyen d'un dépérissement des parties intérieures bordières de l'inlandsis toujours dans la direction proximale, mais au moyen d'une alternation continuelle des phases d'avance (de poussée), du stationnement et de la régression, c'est à dire au moyen d'une répétition continue de ces phases. Ce mécanisme peut etre figuré d'une manière suivante:

1) stationnement de l'inlandsis et formation de moraines frontales et de sandres,

2) retraite de l'inlandsis sur une distance non précisée,

3) avance de l'inlandsis et attouchement par l'inlandsis des formes délaissées dans la phase première,

4) nouvel stationnement ou la retraite immédiate (de nouveau sur une distance non précisée),

5) stationnement de l'inlandsis, mais déjà sur une position plus proche du centre de l'inlandsis.

L'analyse de ce mécanisme nous permet de remarquer que pour qu'il y ait une régression de l'inlandsis on ne peut pas admettre un nouvel stationnement dans la phase 4, parce que dans ce cas là il n'y aurait pas de régression. Il faut admettre que dans la phase 4 doit avoir lieu une retraite momentanée ou presque momentanée de l'inlandsis- la régression de son front- parce que si le stationnement de l'inlandsis dans la phase 4 était de longue durée, il en résulterait la formation de moraines dites d'accumulation (Satzendmoränen). De telle manière les formes morainiques précédentes devraient etre soit cachées sous un manteau des dépôts morainiques nouveaux (moraines „traversées") soit anéanties, mais dans ce cas là il n'y aurait pas aucune preuve de leur existence antérieure.

Il s'en suit, que la retraite du front de l'inlandsis se fait en certains „paroxismes" qui s'effectuent, conformément aux deux conceptions sousdites controverses de deux manières:

a) comme des périodes répétées du stationnement sur les positions avancées de plus en plus vers la direction proximale de la calotte glaciaire,

b) comme des périodes répétées du stationnement, de la régression, de l'avance, d'une nouvelle régression et d'un nouveau stationnement- donc aussi comme un secteur du temps entre deux stationnements- mais contenant une période d'une grande mobilité du front de l'inlandsis.

Il est évident, que l'acceptation d'une telle „gymnastique" du front de l'inlandsis est basée essentiellement sur l'image du „comportement" du front des glaciers montagneux contemporains, dont il a été question au début de cet article. Chez les glaciers montagneux l'inertie de la glace envers les impulses, qui agissent soit au front, soit dans la zone d'alimentation du glacier, est proportionelle à la masse de la glace qui prend part à ce processus et est assez petite. Elle représente une mesure de grandeur d'un ordre tout différent de l'inertie des masses gigantesques de la glace de la calotte glaciaire.

Les autres arguments avancés par les partisans de cette „gymnastique" du front de l'inlandsis, nommée plus haut, ne peuvent pas du tout etre considérées comme convaincantes. Par exemple l'existence d'une couverture argileuse dans la partie proximale des „moraines frontales de poussée" ou „d'oscillation" est considérée comme une preuve d'attouchement par le glacier des dépôts, déposés auparavant par lui pendant la phase du stationnement. Le processus même de poussée des matériaux morainiques est pris pour la preuve de l'oscillation. Cependant l'existence de l'argile morainique dans la partie proximale des collines morainiques peut être expliquée facilement par le contact du matériel morainique avec la glace saturée du détritus morainique sur le bord de l'inlandsis, et qui ne fut pas fondue par les eaux pendant le stationnement, sans avoir recours aux „oscillations" du bord de l'inlandsis. L'acceptation du stationnement de l'inlandsis sur cette place implique l'existence d'une certaine quantité des eaux de fonte et son résultat sous forme de lavage du détritus morainique dans la partie distale, ce qu'on observe réellement. Cependant du moment de l'acception d'un stationnement de l'inlandsis il n'est pas nécessaire d'accepter son oscillation.

Une autre question c'est le problème des dislocations dites glacitectoniques. Comme le montrent des nombreuses recherches sur les formes des dislocations qui sont rencontrées dans les dépôts morainiques des „moraines de poussée" — elles peuvent être expliquées, comme p. ex. les failles, non seulement comme des structures de pression dynamique (donc causées par l'avance, par les oscillations de l'inlandsis), mais aussi comme des structures de subsidence (structures de „gravitation"), causées par la fonte de la glace, ensevelie sous les dépôts morainiques. Elles peuvent alors être expliquées sans avoir recours à l'acceptation de l'action de la pression dynamique de l'inlandsis qui oscille.

Autres formes des dislocations, comme p. ex. les formes d'extorsion, sont considérées aussi comme formes de la pression de l'inlandsis, mais de la pression statique (comp. G. Keller [21] de la glace immobile. Elles ne peuvent alors prouver l'existence de la pression dynamique, de l'oscillation. Les renversements des couches, p. ex. l'inclinaison des couches des dépôts fluvioglaciaires dans la direction proximale, ce qui a été considéré comme une preuve de la „poussée" et de la formation des „écailles" des dépôts de sandre par l'inlandsis qui „oscillait", peuvent être expliquées aussi bien comme le détournement de l'inclinaison proximale des couches, déposées sur la glace en résultat de la fonte de cette glace, qui soutenait auparavant ces dépôts. Les formes de plis même peuvent être expliquées, comme l'a montré Z. Klajnert [22] dans son étude sur la genèse des Collines de Domaniewice, comme des structures de coulée des dépôts saturés de l'eau-comme des „structures de gravitation".

Toutes les preuves de l'„oscillation" du front de l'inlandsis, analysées plus haut, sont donc au moins „équivoques" et pour cela même ne constituent point des preuves sûres. Comme le montre en outre l'analyse attentive de la plupart des travaux, qui s'occupent du problème de la régression de l'inlandsis, la preuve la plus importante de l'occurence des oscillations ce sont les dislocations dites glacitectoniques, dont on a discuté l'origine auparavant. Ces dislocations sont expliquées précisément comme l'effet des oscillations („circulus vitiosus" de l'argumentation).

Cependant ce sont seulement les distorsions de l'arrangement des couches dans les dépôts morainiques avec une très grande (prépondérante) participation des dépôts du substratum pléistocène (Tertiaire, Mésozoique), qui peuvent servir comme la preuve de la pression dynamique- de l'avance de l'inlandsis. Néanmoins, dans le dernier cas l'occurence de ces „xenolithes" peut être expliquée, elle aussi, par l'abrasion ou l'exaration du substratum sous la glace et non pas devant le front du glacier et par l'incorporation de ces fragments dans la masse glaciaire le long des surfaces de glissage (comp. G. Swinzow [25] — „abrasion, plucking and incorporation of debris along stream planes"). C'est seulement l'occurence de très grandes masses du substratum disloquées (qu'on ne peut pas considérer comme „debris"), qui peut être considérée comme la preuve de l'existence des „moraines d'extorsion" (le terme de „moraine de poussée" a l'origine dans la conception des „oscillations", qui comme on voit, ne peut être considérée que seulement comme le postulat de la théorie de la déglaciation frontale, mais qui n'est point irréfutablement prouvée).

Toutes ces considérations mènent à l'avancement d'une conclusion suivante: il n'y a aucune preuve sûre pour la thèse que l'inlandsis se retirait des pays bas par de nombreuses oscillations et à cause de cela on peut avancer la thèse première, c'est à dire que la régression de l'inlandsis doit être considérée comme „les périodes répétées du stationnement de l'inlandsis sur les positions, toujours plus avancées vers la direction proximale de la calotte glaciaire, sans de nombreuses oscillations". Il s'en suit que la déglaciation zonale est une déglaciation „normale" des terrains des pays bas. Cela peut être prouvé par l'analyse attentive de la géomorphologie de zones marginales de la dernière glaciation d'un territoire typique d'accumulation glaciaire sur l'exemple du pays bas de la Grande Pologne.

III

La description des formes de la zone marginale et de la déglaciation dite aréale peut être trouvée dans un tel nombre d'articles de l'auteur, traitant du territoire en question, qu'il n'est pas nécessaire de la répéter en détail (comp. T. Bartkowski [3, 4, 5, 7, 8, 10, 12]). On peut et on doit cependant citer les conclusions fondamentales, qui peuvent en être tirées.

Ces conclusions ont trait d'abord au mécanisme même de la formation de la zone marginale pendant le bilan d'équilibre (voir fig. 1 et 2).

Dans cette zone on peut distinguer trois subzones:

a) La plus intérieure, qui se forme sur la place d'un grand „crevassement" de l'inlandsis et où se forment ensuite des nombreuses „collines morainiques". Ces collines sont bâties soit entièrement d'argile morainique, soit elles possèdent le noyau du matériel fluvioglaciaire,

Fig. 1. Zones marginales dans la partie centrale de la Plaine de la Grande Pologne (Wielkopolska) pendant la dernière glaciation (Wurm)

1 — zone de collines morainiques („a"), 2 — zone des formes d'accumulation fluvioglaciaire en lieu d'effusion des eaux de fonte à l'extérieur („c"), 3 — lieu d'effusion des eaux de fonte à l'extérieur de la glace (embouchures des chenaux glaciaires perpendiculaires (du système radial)), 4 — cônes de sandre, 5 — chenaux glaciaires marginaux- territoire de la „dissection marginale", 6 — terrasse de kame, 7 — formes d'accumulation fluvioglaciaire dans les crevasses et les cavités dans la glace passive ou morte (kames, oesar, plateaux de kame), 8 — terrains d'accumulation fluvioglaciaire du type de „pradolinas", 9 — plateau morainiques et les escarpements, 10 — „moraines d'extorsion" avec le matériel tertiaire disloqué glacitectoniquement, 11 — stade de Leszno (Brandenbourg), 12 — stade de Poznań (de Francfort), 13 — subzones de la zone marginale intraglaciaire, 14 — territoire de la dépression fossile Obra-Płonia (d'après A. Kowalska 1960), 15 — limites de la zone marginale intraglaciaire

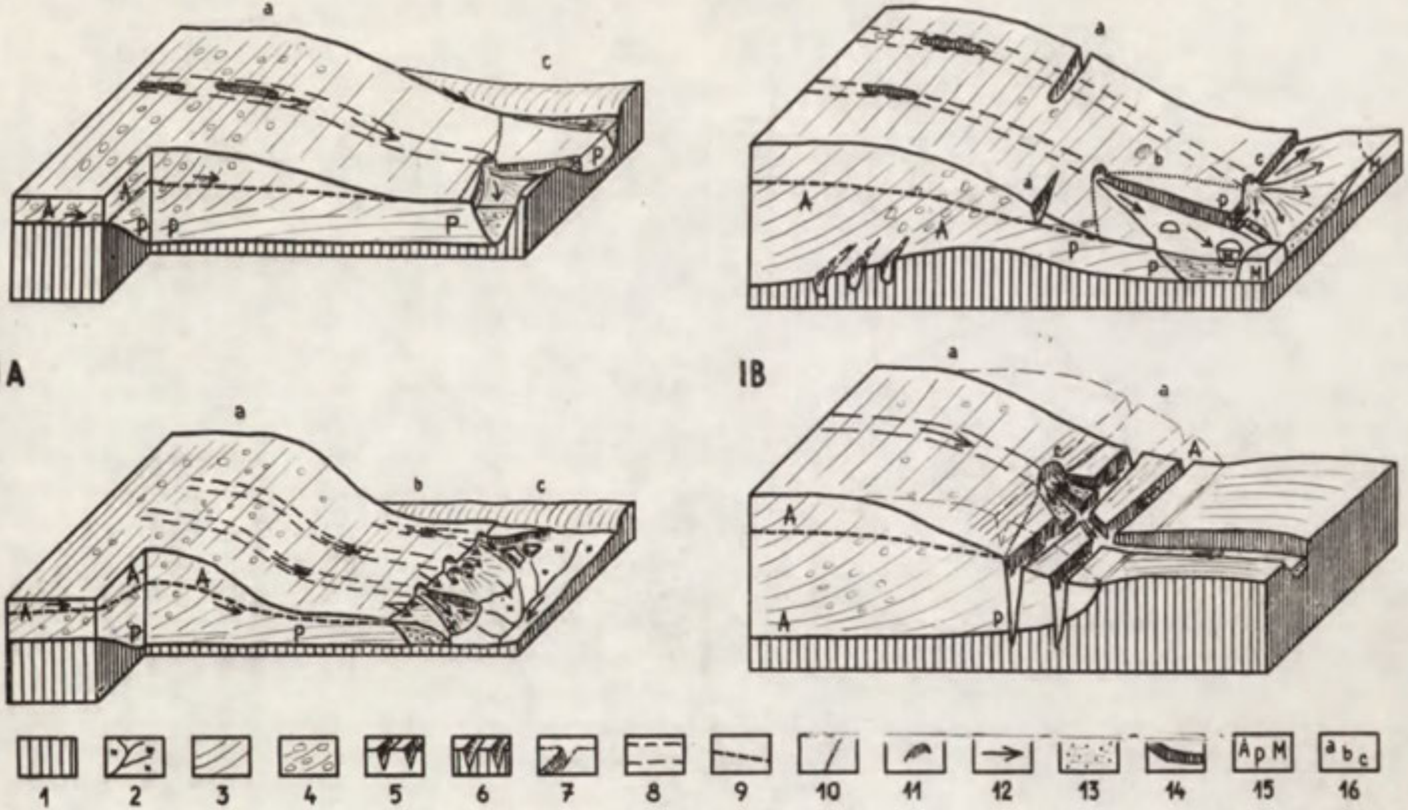

Fig. 2. Schéma du mécanisme de la formation de la zone marginale dans les conditions de l'existence de la depression fossile (I A, I B) et élévation fossile (II A, II B)

1 — substratum, 2 — „pradolina", 3 — surfaces de glissage dans l'inlandsis, 4 — crevasses et cavités dans la glace, 5 — crevasses disséquant la glace, 6 — crevasses disséquant la glace et la substratum 7 — crevasses marginales de l'étape antérieure, précédant le stationnement I B, 8 — contours du chenal inglaciaire, 9 — nappe d'eau „inglaciaire" circulant dans les crevasses et les cavités dans la glace, 10 — ligne joignant les lieux d'effusion des eaux de fonte à l'extérieur de la glace, 11 — embouchure du chenal glaciaire — „porte glaciaire", 12 — direction de circulation et d'écoulement des eaux de fonte, 13 — matériel fluvioglaciaire, 14 — escarpement, 15 — A, P, M — glace active, passive, morte, 16 — a, b, c — subzones de la zone marginale intraglaciaire: „a" — du contact de la glace active avec la glace passive, „b" — de circulation des eaux de fonte dans la glace passive, „c" — d'effusion des eaux de fonte à l'extérieur de la glace

recouvert d'un manteau d'argile morainique (quoiqu'on peut rencontrer ici aussi des collines entièrement dépourvues de ce manteau). Ce crevassement s'est formé dans le lieu de contact de la glace active avec la glace passive, ce qui a pour résultat le mouvement ascensionel des masses glaciaires (comp. J. F. Nye [24]) et ce qui a mené à la formation de nombreuses crevasses dans l'intérieur du glacier (surtout dans ses parties basales). C'est la subzone „a" (voir fig. 1 et 2).

b) La subzone moyenne (transitoire) „b", dans laquelle existait la glace passive de plus en plus mince dans la direction distale, comme le résultat d'ablation et qui est moins „crevassée". Dans cette subzone les eaux de fonte de l'inlandsis, qui dans la subzone précédente s'infiltrèrent dans les crevasses et les cavités existant dans l'inlandsis, circulaient dans les parties basales de l'inlandsis. Elles n'apparaîssaient encore à l'extérieur de l'inlandsis, mais elles transportaient le matériel fluvioglaciaire, „lavé" de la glace.

c) La subzone extérieure-subzone „c" — dans laquelle les eaux de fonte surchargées de matériel fluvioglaciaire, effluaient à l'extérieur de la glace passive (à l'image de sources karstiques), répandant partiellement sur la glace passive, dejà très mince et partiellement sur la glace déjà morte, ou entre les blocs de la glace morte, le matériel fluvioglaciaire en forme de cônes de sandre et de collines de kames.

Ces trois subzones sont rencontrées cependant dans des variantes diverses, qui dépendent des circonstances locales. Par exemple dans de grandes dépressions fossiles du substratum (Dépression Obra-Płonia d'après A. Kowalska [23]), où la glace passive gîsait profondément et s'étendait bien loin dans 1, „avant-pays" de la zone d'effusion des eaux de fonte (de la subzone „c"), cette subzone occure encore dans la glace passive, ce qui a mené à la formation d'une terrasse de kame typique au pied du Rempart de Bukowiec (comp. T. Bartkowski [4, 9]) et fig. 2-II A; la subzone du crevassement est ici signalée par l'existence d'un très grand nombre de collines de kame (d'un vrai „champ de kames"), qui ne possèdent de manteau argileux morainique, au lieu de collines morainiques argileuses de la subzone ,,a". Ce crevassement résulte de la pression de masses de la glace active sur la glace passive (comp. ici F. T. Thwaites [26]). La subzone ,,b" (subzone de la transition des eaux de fonte) est représentée dans cette partie de la Dépression de l'Obra par des plaines plates, des bassins d'accumulation lacustre, des lacs glaciaires des environs de Gorzycko, Międzyrzecz et Policko (comp. T. Bartkowski [4]).

Dans la partie de la zone marginale du stade de Leszno de la dernière glaciation, située sur la limite extrème de la dernière glaciation dans la partie méridionale de la Dépression Obra-Płonia (Pays de Lacs de Slawa), où l'avant-pays de l'inlandsis était libre de la glace, fut accumulé un „rempart d'accumulation fluvioglaciaire" du type marginal (fig. 2-I A) duquel sortaient des cônes de sandre, qui se versaient dans la dépression déjà existante de la Pradolina Glogów--Baruth de la façon analogue est formée la zone marginale dans la dépression de la Cuvette de Lubsza (Rempart Brody-Drewitz, voir T. Bartkowski [7]). La subzone „a" est représentée ici par des nombreuses collines de kames, considérées jusqu'aux temps derniers comme des collines de moraine frontale (comp. „Collines de Ciosaniec" de B. Augustowski [2]).

L'inventaire un peu plus différent de formes est rencontré dans les zones marginales situées sur les élévations du substratum. Ici l'existence d'un "seuil" du substratum (fig. 2-II B), qui à cause de l'action de l'ablation se faisait sentir de plus en plus à mesure que le glace s'amincissait et entravait le mouvement de l'inlandsis a eu pour effet l'arrêt momentané de la zone marginale de l'inlandsis- le stationnement de l'inlandsis. Ici, dans le lieu d'un grand „crevassement" des parties internes de l'inlandsis (subzone „a") se sont formées des collines avec le noyau bâti du matériel fluvioglaciaire ou même sans ce noyau, mais bâties entièrement d'argile morainique. Ici enfin sont accumulées, dans le zone d'effusion des eaux de fonte de l'inlandsis (subzone „c") les cônes de sandre, répandant bien loin sur l'avant-pays (où peuvent encore occurer des blocs de la glace morte) les graviers, les sables et les limons fluvioglaciaires. Il faut remarquer encore, que selon les conditions locales, le lieu d'effusion des eaux de fonte (point „c") peut se trouver sur la lisière soit de la subzone „b", soit de la subzone „a" ou même exister pendant l'activité simultanée de deux systèmes de drainage (fig 2-II B). En conséquence le cône de sandre plus enfoncé (dans la partie intérieure de l'inlandsis) peut recouper le cône de sandre avancé plus en dehors (ici la base locale d'effusion des eaux peut se trouver en différentes hauteurs). Il peut arriver aussi que le cône de sandre, accumule par les eaux plus abondantes (p.ex. à l'embouchure d'un chenal glaciaire) recoupe en même temps un cône de sandre, accumulé par les eaux moins abondantes, coulant immédiatement de la surface du bord de l'inlandsis et délaissant le matériel fluvioglaciaire tout près du rebord de la glace (fig. 2-I A). Parfois aussi le cône de sandre, accumulé sur la glace peut montrer, après la fonte de la glace. les recoupements causés par la fonte de la glace pure (de congélation) qui a été recouverte par ce sandre.

Différemment de la zone marginale en intérieur de l'aire de la dernière glaciation (ici la zone marginale du stade de Poznan — fig. 1 et 2-II B) la zone marginale, formée au bord extérieur de cette glaciation (zone marginale du stade de Leszno — fig. 1 et 2-I1 A) montre un faible développement de la zone de la glace morte. Ici on observe un faible développement des subzones „a" et „c", et un très intense- on pourrait dire gigantesque — développement de la subzone „b"- subzone de la glace passive. C'est la zone de la transfluence et de la circulation des eaux de fonte, disséquant le substratum (chenaux marginaux, comp. T. Bartkowski [6,7]), et qui transportaient le matériel fluvioglaciaire accumulé dans la subzone „c". C'est la zone de la „dissection marginale", très commune dans la zone marginale (T. Bartkowski [7,8,10]).

IV

Il n'est pas nécessaire de multiplier des exemples qui peuvent prouver la validité de la notion de la déglaciation zonale pour le territoire des pays bas. Pour en venir à la conclusion finale, il faut seulement se rendre encore compte de l'aspect fondamental de cette notion. Il se base sur le fait, que la notion de la zone marginale est étudiée dans les termes de l'hydrodynamique du bord de l'inlandsis (de son "marge" et du "bilan de la calotte glaciaire"). Cette approche nous permet d'étudier d'une façon complexe la morphogénie de la zone marginale et de la déglaciation- des éléments les plus importants dans la géomorphologie glaciaire.

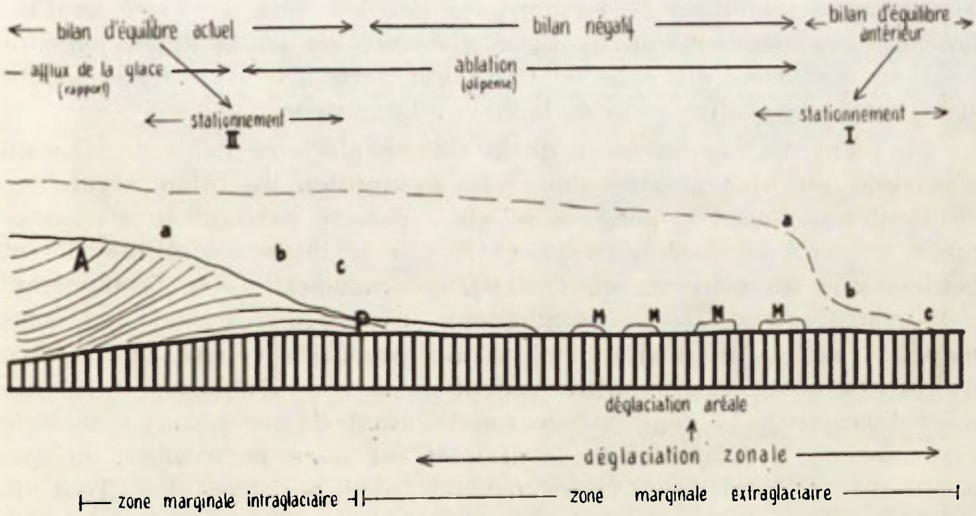

Fig. 3. Schéma des conditions de la formation de la zone marginale
A — glace active, P — glace passive, M — glace morte, a, b, c — subzones de la zone marginale

L'essai d'une telle approche complexe démontre le schéma graphique ci joint (fig. 3). Comme on voit dans le moment du bilan d'équilibre il n'y a pas, comme on l'a dit déjà auparavant, de la régression. Dans cette circonstance là se forme une zone marginale intraglaciaire en principe triple, avec des modifications, qui résultent des conditions locales du drainage du bord de l'inlandsis. C'est dans ce moment là que la morphogénie de cette zone est conditionnée surtout par l'hydrodynamique du bord de l'inlandsis. L'établissement cependant du bilan négatif de la calotte glaciaire mène à l'extinction du mouvement de la glace en un "paroxisme" dans toute la zone — plus ou moins étroite- dans laquelle a vaincu l'ablation (morphogenie conditionnée surtout par le bilan négatif de la calotte glaciaire) et dont l'étape suivante-finale-d'évolution mène à la transformation de la déglaciation zonale en déglaciation aréale (morphogénie conditionnée par l'hydrodynamique de la glace morte et l'influence du substratum).

Au point de vue de l'hydrodynamique du bord de linlandsis on peut concevoir la zone marginale comme composée de deux zones partielles: zone marginale intraglaciaire, qui comprend en soi la subzone du contact de la glace active avec la glace passive („a"), subzone de la glace passive („b") et subzone d'effusion des eaux de fonte jusqu'au point „c" (d'effusion à l'extérieur — lus précisément — sur la surface de la glace passive) et la zone marginale extérieure, qui comprend en ,soi la zone bien vaste de la morphogénie avec le concours des restes de la glace passive et de la glace morte et le terrain de la dissection (dénudation) de l'avant-pays par les eaux de fonte de l'inlandsis (zone de sandres). La ligne divisante est ici la ligne, joignant les lieux d'effusion des eaux de fonte, qui circulaient dans les crevasses et les cavités dans l'intérieur de la glace à l'extérieur.

Du point de vue du bilan de la calotte glaciaire l'aire d'extension d'ablation est plus grande que l'aire d'extension du bilan négatif — elle embrasse aussi la zone de la glace passive pendant le stationnement du bord de l'inlandsis-quand il y a le bilan d'équilibre. Il est évident que du moment, où l'inlandsis commençait à se "comporter" à la manière d'un glacier montagneux- c'est à dire quand il a commencé à réagir de même manière aux impulses venant de la zone d'alimentation et aux impulses venant de la zone d'ablation (influence de substratum), la déglaciation zonale montrait de plus en plus le caractère de la déglaciation frontale. C'est dans ce moment là que pouvaient se former de vraies (réelles) moraines frontales. Tout de même ce n'était pas le territoire de pays bas non plus mais le territoire distal de la pente des montagnes ou de hauts plateaux, sur lesquels s'est formée et mainenue la première (initiale) et la dernière (de rélict — avant la disparition) calotte glaciaire de montagne ou de haut plateau. A cause de cela on ne peut pas déduire des conditions, qui règnent p.ex. dans la zone marginale de la petite calotte glaciaire de rélict de Vatna Jökull en Islande-qui représente le type du glacier mixte: mi montagneux et mi piédmontais-les lois du "comportement" de la zone marginale de l'inlandsis pléistocène. On peut parler ici seulement d'une certaine analogie et l'analogie ne peut pas servir comme prémisse dans les recherches scientifiques (comp. le commencement de cet article).

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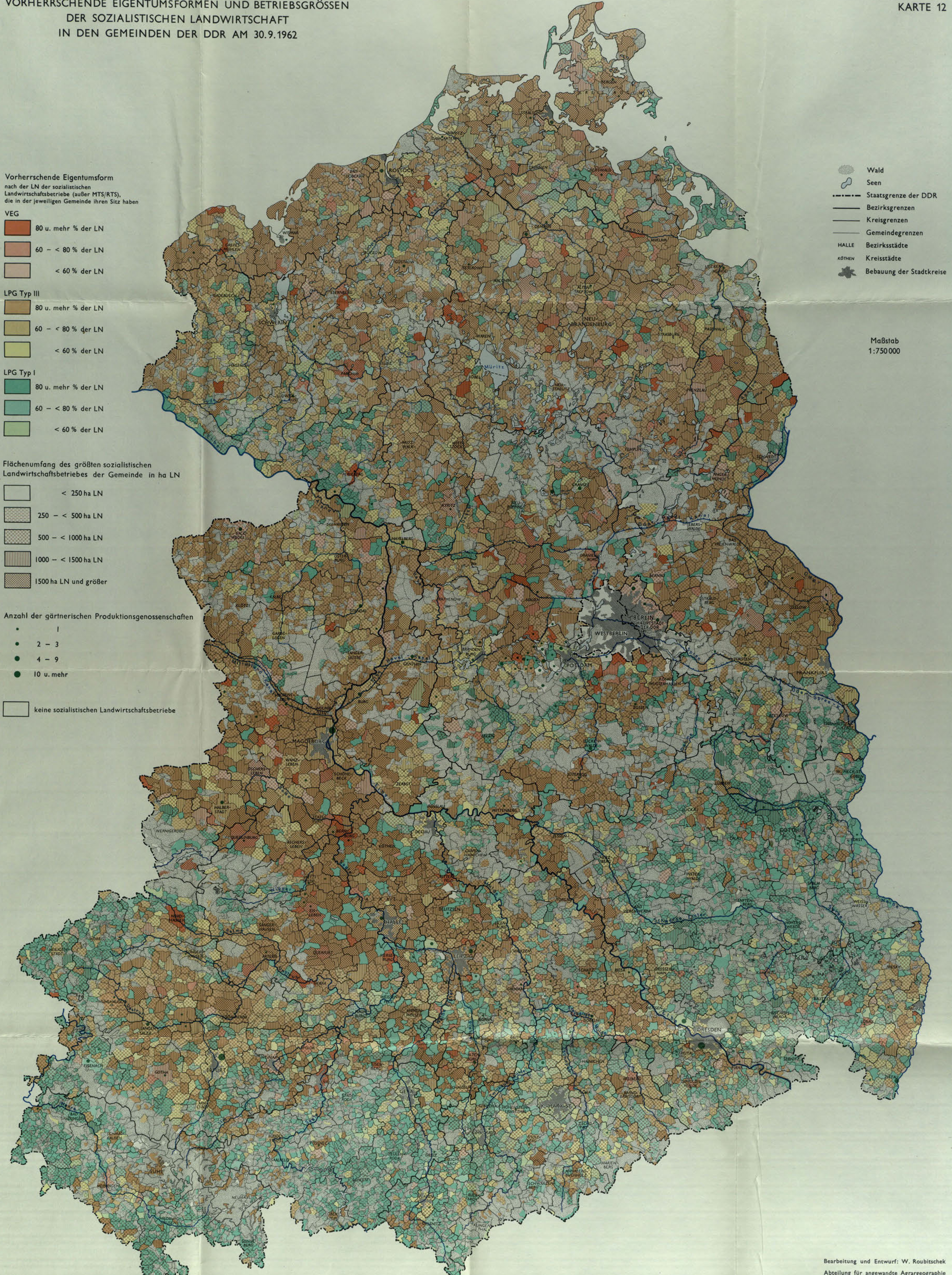

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