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PHOTOINTERPRETATION AS A METHOD IN STUDYING SPATIAL
STRUCTURE OF A TOWN. A CASE STUDY OF EŁK.

Most of the research work on the spatial structure of towns has been carried out so far by traditional methods, such as site surveying, cartographic studies or registration of data. The first papers on the urban problems contained anthropogenic descriptions and studies concerned with the physiognomy of towns (M. Mrazkówna, S. Leszczycki, W. Rewieńska). Interesting from this point of view proved to be dissertations from the interwar period. These mostly dealt with the morphology of towns and their peculiar features, and while often going into details they were seeking an answer to the question: "what relations do actually exist between geographical environment and a spatial structure of a town" (e.g. Z. Simche, M. Kiełczewska-Zalewska). Much interest has been taken in the line of studies covering urban transformations and the evolution of urbanized districts (H. Leonhard-Migaczowa). In recent years, morphological studies have been embarked on once again to develop with particular intensity in such urban centres, as Warsaw, Cracow and Łódź (K. Dziewoński, M. Koter, K. Bromek, A. Werwicki, A. Jelonek, S. Liszewski). Polish authors were influenced in their work by rich world literature on this subject of German, French and British researchers. A numbers of new theoretical concepts on the internal structure of towns have come from American authors, among whom sociologists played undeniable part. They not only linked their theories with anthropogenic activity, but with the physico-geographical conditions as well. As seen from the brief review of literature covering this very comprehensive subject of urban problems, too little attention has been given so far to the direction of morphological studies based on a dynamic approach to the problem so that also geographical environment might be taken into account. This has been partly due to the search for some new currents and to the arduous methods such research work normally carried along

with it. Now, the possibility of using aerial photography for the purpose has induced the author of this paper to take up the theme and carry it on.

Air-photographs have proved to be a valuable asset, and a very convenient instrument at the same time, in applying photointerpretation as a method for investigating urban development. Particularly in the seventies aerial photography became popular in various research activities which for the sake of convenience may be classified as coming under the following three headings: (1) Urban land uses and their transformations; (2) Official numbering of population; (3) Assessment of the socio-economic conditions.

The earliest and most advanced is the theme covering the use of land in the towns (pioneering works by G. W. Collins, A. H. A. El-Beik, R. Chevalier). The dynamism of changes in land uses was analysed by means of aerial photography by D. M. Richter and E. Falkner. Numbering of population with the use of photographic material was a challenge to G. W. Collins, A. H. A. El-Beik, P. O. Adeniyi, S. Kraus, J. Ryersen, L. Senger et al. More recently also satellite imagery sources — as their number continues to go up — are tried to be utilized for the purpose of estimating the number of population (Ch. E. Ogrosky, J. Iisaka, E. Hegedus). So far most advanced seem to be the studies on producing computer maps from material supplied by satellites (A. Grey, F. Westerland, L. Gaydos, W. Newland, M. Field).

Vital, but nonetheless also difficult, is the problem of assessing socio-economic conditions of the population on the basis of aerial photography material (L. Mumbower, J. Donghue, F. M. Henderson, J. J. Utano). In addition to such highly specialized fields as transport or building, aerial photography may also serve as a basic source of information and inventorying material in a complex approach to the problem of colonization (M. Chilczuk) and urban planning (K. Ford).

Aerial photography, being a true mapping of the land surface, represents in itself an important source of information because of its reliability not falsified by any biased selection of data. Moreover, owing to the high uniformity of data obtainable at various stages in the past and because of a possibility of collecting such data in the future time, such a material becomes a valuable aid when studying phenomena with a dynamic approach to the problem. Unlike a map, photography furnishes an up-to-date image of the spatial development of the area under study with a multitude of unselected details which, as a very rich source of information, may be utilized in more ways than only one.

Most Polish territories, as they are now after World War II, have been photographed from the board of aircraft more than once. By selecting photographs from various periods of time one can follow with ease characteristic trends observed in the development of a town. For the town of Elk the years of 1970 and 1979 were chosen as the time during which Poland experienced an investment boom and the rate of industrialization was very high. A dynamic growth in the urbanization processes followed as a result of this and it seems therefore appropriate and interesting to verify if the all-country's tendency found its expression in the history of the towns of Suwałki Province, too, and to what extent the geographical environment may be held responsible for changes having taken place in the internal structure of the town. Before we, however, proceed with the analysis of the internal (or spatial) structure to see how it was developing over the past decade on the basis of photographic material from 1970 and 1979, it will be necessary to learn first the specific geographical situation of the town and its surroundings, and to get acquainted with its historical growth.

Colonization of the site around Elk began in the 15th century. People from all over the Mazovian Land were flowing into this place. On the turn of the 14th century a castle was built by the Teutonic Knights on the island in Lake Elk, replacing the older one belonging to the Jadzwingi. Fishermen were settling alongside the Lake, building their houses there. The main street of Elk as it is now, being parallel to the longer axis of the lake and widening near the Church into a square, proves characteristic of the single-street Slav villages in their origins. The settlement of Elk, which kept on developing at a quick pace because of its favourable position, was granted civic rights in 1445. Further growth of the town was jeopardized as a result of Tartar invasion and fire in 1656, when only the Castle on the island evaded destruction. Civic rights were repeatedly granted to Elk in 1669, but restrictions imposed upon Polish colonists in this area and upon holding various offices by Poles slowed down further urban growth. No more successful was the 19th century, either, when the town suffered a great deal during Napoleonic wars and due to raging fires. That is why Elk has no, or almost no, historical buildings and its architecture fundamentally goes back to the 19th century. A more dynamic development of the town started in the second half of the 19th century. The main reason for a fast growth in the number of population, from 3,898 in 1850 to 6,671 in 1880, was that a railway junction of some importance came to function in Elk. Railway line passing through the town brought about revival of trade, in the grain bu-

siness in particular. Industry based on local natural resources kept on expanding. New factories, those manufacturing plywood and tinned food, a brickyard, sawmills, grain mills, dyehouses, breweries, and a tannery, were erected. In 1889, the island got connection with the land via the way of an earth-fill dyke and the castle was transformed into a prison. As a result of hostilities Elk was severely destroyed in World War I. In the postwar plebiscite it grew a part of the Third Reich. During World War II Elk came to be known as a busy, strategically important, railway junction, but war damages due to hostilities were very high, almost 45 per cent. The Mazurian population suffered heavy losses. Only 6,104 in 1946, the population of the town rose to 16,480 in 1948, and to 23,080 in 1960, 32,000 in 1970, and 38,175 in 1980.

The position of the town which is spreading along the eastern borders of Lake Elk is fairly favourable. Elk occupies an elevation 130 to 135 metres above sea level, on one of its sides sloping down towards the Elk River, northwardly the site — after passing a depression — rises to a height of 150 metres above sea level. In the eastern direction the surface of the land stabilizes reaching 125 metres above sea level. The western bank of the lake may be divided into two parts: the northern part with elevations up to 150 metres above sea level, and the southern flat part not exceeding 130 metres in altitude.

Morphometrically, the centre of the town is spreading over a low hill with a wavy plain cut by heights and hills stretching in the north-eastern direction. In the west there predominate wavy plains with large-radius and small-radius hills rising out of the ground here and there. A vast wavy plain which preponderates in the south, is built of the out-wash flatland sands and gravels. The north-western, most picturesque, part of Elk and its surroundings is made of clays with sandy and gravelly inclusions. The terrains westwards of Lake Elk are built of clays deposited here from erosional meltwaters, and of peats filling out the depressions. East of Elk there prevail sands and gravels, as well as peats in the depressions.

Fairly diversified is the soil cover. Lixiviated brown earth is predominating east of the town, but in the Elk River Valley we come across peatsoil complexes and fen soils. West of the town brown earth is the most common soil.

Waters from the Elk surroundings flow right into Lake Elk, Lake Szarek and into the Elk River. The terrains north of the town represent a catchment area with waters gathering on their surface and having no outlet. Mostly absorptive catchment areas with surface waters having no outflow channels are found to the south of the Lake. Valley

type waters exhibiting a periodically reversible equilibrium in the draining and watering processes are characteristic of the land alongside the Elk River. Shallow surface waters occur in the depressions. The entire eastern part of the land contains deep infiltration-equilibrium-type out-wash waters, the filtration-equilibrium type waters occurring in the north-western part.

Local climate is well diversified. The built-up land is characterized by a high absorption of the sunray radiation. River depressions feature greater oscillations in temperature and higher relative air humidity, wind velocities being lower in this area. Peatbogged areas record lower air temperatures, with ground frosts likely to occur during the vegetation periods. Climate in the north-western part, where thermal conditions are more favourable, is the mildest.

Photographic material for Elk in its administrative limits applies to two time-profiles, 1970 and 1979, and represents enlargements of 1:5,000 from a panchromatic 1:10,000 source. At the initial stage, photographs served as an inventorying material. The following elements of the town were identified from these photographs: low and high constructions, in their number also new blocks of flats; farm buildings; industrial complexes and administration buildings. Industrial grounds have been distinguished, extracting industry having been treated as a separate branch of industry. Greens, i.e. parks, squares, recreation grounds, allotment gardens and graveyards, have been identified. Orchards, vegetable gardens, meadows and pastures have been spotted. Woodland, farm land, barren land and waters have been suitably classified. Transportation grounds have been marked out with line of distinction drawn between major roads (arterial roads or highways), minor roads, walkways and railway lines. With such a legend in hand, two images of the 1970 and 1979 towns have been framed with a number of physiognomical units clearly identifiable:

- (1) Centre of the town with all its commercial facilities;
- (2) Residential quarters with apartment houses;
- (3) Residential quarters with individual houses;
- (4) Industrial quarters with storage facilities;
- (5) Recreation grounds for resting.

The clear-cut centre of the town is a melting point in which the state of prewar investment intermingles with the continually superimposing processes of contemporary projects. It is cut by a network of well-visible transportation routes which mark out the main streets of the town. Apartment buildings with a strong tendency towards changing into big blocks of flats form filling tissue of the development. Indivi-

dual houses, on the other hand, assuming the appearance of compact settlement group round the centre of the town, spread in particular along the communication lines (directional development). Industrial quarters with their storage facilities go in company with the raw materials which are being mined in the neighbourhood (clay, gravel, sand), or with the arterial roads and railway lines having adequate storage spaces and warehouses built nearby and alongside them. This quarter is clearly seen in the eastern part of Elk. Recreation grounds include a strip of land near Lake Elk, parks in the centre of the town, and allotment gardens in the vicinity of residential quarters with apartment buildings.

To perform a more detailed quantitative analysis of land uses and changes taking place in them, a chorochromatic geometrical map has been designed with its basic grid cell, rectangular in shape, covering 1/2 ha of land in area. The map contains 12 classes, suitably generalized beforehand. Low buildings, high buildings, industrial and utility buildings, industrial-storage buildings, communication grounds, greens, wocodland, waters, farm land, barren land and non-classified land. The 1970 and 1979 maps, when placed one upon the other, give the possibility of following up changes which took place in the urban structure.

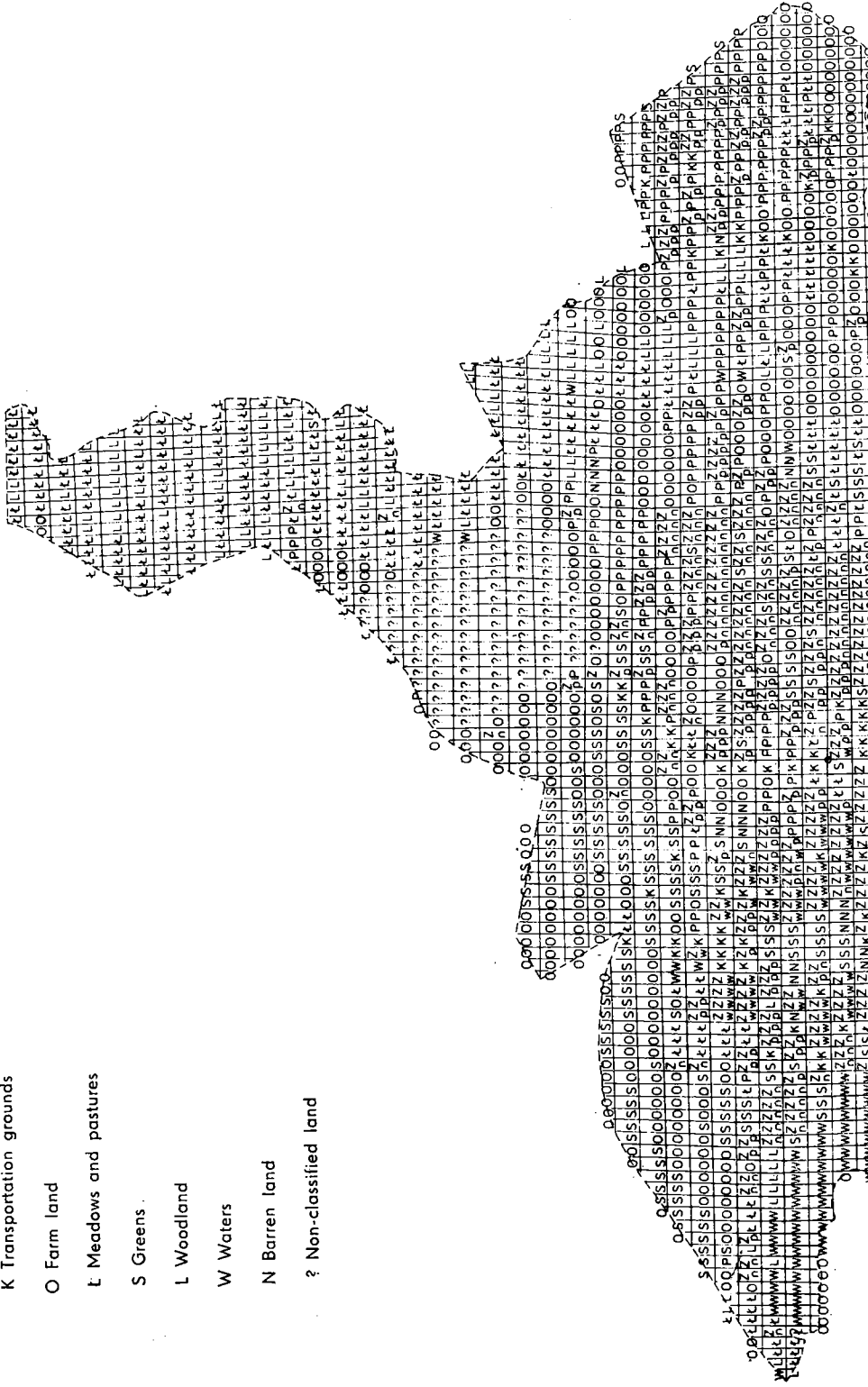
An increase in the development of high building in the centre of the town proceeded at the expense of low building, and on the outskirts of Elk at the expense of farm land, greens and meadows. Particularly quick was the pace at which blocks of flats were constructed in the northern part of the town. In the centre of the town, the process like this can be explained by an action under which older houses are being replaced by the newer ones. As regards ingress into the new terrains, this remains closely linked with the particular configuration of surroundings which on one side are constrained by Lake Elk and on the other, eastern, side cross the railway line with a large junction that has rendered further development of the town in that direction much more difficult because of only one crossing, an underpass, existing at this place. In consequence, despite the fact that this site lends itself to further expansion, building kept on developing rather over the terrains more diversified in their relief. While finding no room for itself in the centre of the town, the new residential low building development concentrates on the fresh-occupied farm land. As regards industrial grounds, also these have expanded heavily. Along with a rise in building activities there has also been an increasing demand for aggregates. Quarries of sand and gravel are in operation in the town itself and on its outskirts. Such a location of the sand and gravel pits is a na-



Fig. 1



- Z Low buildings
- Z High buildings
- Z Industrial buildings
- P Industrial quarters
- K Transportation grounds
- O Farm land
- L Meadows and pastures
- S Greens
- L Woodland
- W Waters
- N Barren land
- ? Non-classified land



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Fig. 2

tural outcome of the desire to cut costs of transportation and to avoid inconvenience of carriage from more distant places. And also in this case the farm land had to retreat in order to make room for the newly opened mines. Industrial grounds are situated in the eastern part and thus, having been isolated from the rest of urban settlements, they do not interfere with the life of inhabitants. To make access to the factories, whose industrial activities have an all-country's coverage, easier and to relieve heavy traffic in the town, a new ring-road has been proposed and is now under construction.

To ensure supply of vegetables and fruit for the population, new terrains have been assigned for plantations while people living in the blocks of flats got into possession of allotment gardens situated behind the railway line. No recreation grounds, except for some housing estate greens, emerged in the town itself. Banks of Lake Ełk are high and slopy enough to render any form of recreation rather doubtful. Equally unadvisable proves also practising of aquatics in the Lake, because of a high pollution of waters due to industrial wastes coming right into the Lake itself or into the Ełk River from the local factories.

A ring of woodland surrounds the urban agglomeration, mostly composed of coniferous forest. Larger forest complexes still prevail in the south-eastern neighbourhood of the town. The area of the dense forest and woodland complexes has remained unchanged. It is only this part of the land which covered by shrubs near the river, canals, and in the gravel mines, now idle, has gone up in its acreage over the years.

In 1970, total area of the town within its administrative limits was 2,904 hectares. The area of residential quarters was approximately par with that of industrial grounds, being 4.3 per cent of the total each; transport 4.1 per cent; administration and services 1.5 per cent; greens 1.1 per cent. The remaining 84.7 per cent accounts for farm land, meadows and waters. Data as above confirm the fact that industrial and transport functions are the dominating ones in Ełk. In 1979, the industry advanced yet more in its importance and assumed a leading position with the area of grounds occupied, ranging to 5.5 per cent. This found its expression in the development of residential building, high building in particular, whose acreage rose from 1.5 to 3 per cent.

Figures quoted will be helpful in carrying out spatial comparison of urban dynamics, influenced not only by geographical conditions but by historical and economic factors as well.

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