RENATA DULIAS, ANDRZEJ T. JANKOWSKI*

THE MAP OF RELIEF CHANGES IN KATOWICE PROVINCE PART II: MAIN SIGNS OF ANTHROPOGENIC CHANGES OF THE RELIEF

PRELIMINARY REMARKS

Destructive and extremely undesirable changes of the geographical environment in Katowice province make cyclic registration of the changes necessary. It is indispensable, not only for the knowledge about the region but mainly for spatial planning of the province area, to determine the character of changes, rules of their occurence and evolution. The aim of this work is to present one of possibilities of processing information data given in the map of relief changes of Katowice province, which has been prepared by means of photointerpretation method (Jankowski, Zieliński, 1990, p. 17—22) to prepare the *Code map of selected elements of the geographical environment of Katowice province* at a scale 1 : 100 000 (Fros-Dulias, 1984). This map plays partialy a role of an "information bank" concerning land use and changes of the earth surface in Katowice province. It is to present main forms of anthropogenic changes of relief and their spatial layout.

METHODS OF PREPARATION OF THE CODE MAP

During the first stage of elaboration a net of basic fields was marked on a cartographic base at a scale 1 : 100 000. Indicators of anthropopression, found in the map of relief changes in Katowice province at a scale 1 : 50 000, were going to be determined. The scale of elaboration and character of encoded elements was the factor that supported the idea of using artificial basic fields i.e. the squares of the area 4 km^2. The area of the province was covered by the net of squares with a side 2 km. Division into basic fields was begun from the coordinate system where

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the ordinate axis was a line running from West to East through the following places: Kuźnia Raciborska, Rudy, Pilichowice, Chudów, Murcki, Okradziejówko, Myślachowice, Ostrężnice and the abscissae axis was a line running from North to South through the places: Ożarowice, Wojkowice, Siemianowice, Katowice, Murcki, Urbanowice, Brzozowice, Żebrocze. The lines cross each other at Murcki (fig. 1).

During the second stage the fields were filled with the data. There were seven elements forming indexes of anthropopression that were used in each field:

I — urban areas, II — industrial areas, III — afforested areas and tree stands, IV — dumping grounds, V — workings, VI — subsidence, VII — maning areas.

Digital code system was used to unify a method of characterization of the elements-indexes. It is based on the following principles:

— each characterized element has its own place in the code which is presented in a scheme below.

I		III		V		VII
0	0	0	0	0	0	0
	II		IV		VI	

Digits I—VII present the above mentioned elements-indexes.

— analysed features of elements were presented by Arabic digits according to the following pattern:

I — urban areas:

0 — none (they do not occur in the field), 1 — 1 km² of the area is urbanized, 2 — 2 km² of the area are urbanized, 3 — 3 km² of the area are urbanized, 4 — 4 km² of the area are urbanized i.e. the whole field

II — industrial areas:

0 — none, 1 — 1 km² of the area covered by industry, 2 — 2 km² of the area covered by industry, 3 — 3 km² of the area covered by industry, 4 — 4 km² of the area covered by industry:

III — afforested areas and tree stands:

0 — none, 1 — 1 km² of the area covered by forests and trees, 2 — 2 km² of the area covered by forests and trees, 3 — 3 km² of the area covered by forests and trees, 4 — 4 km² of the area covered by forests and trees

IV — dumping grounds:

0 — none, 1 — numerous minor dumping grounds, 2 — sand and gravel dumps, 3 — municipal waste dumping grounds, 4 — coal mining waste dumps, 5 — power plant waste dumps, 6 — dumping grounds of iron, zinc and lead industry, 7 — wet dumping grounds, 8 — other dumping grounds

V — workings:

0 — none, 1 — numerous minor workings, 2 — sand and gravel workings, 3 — clay formations workings, 4 — limestone workings, 5 — dolomite

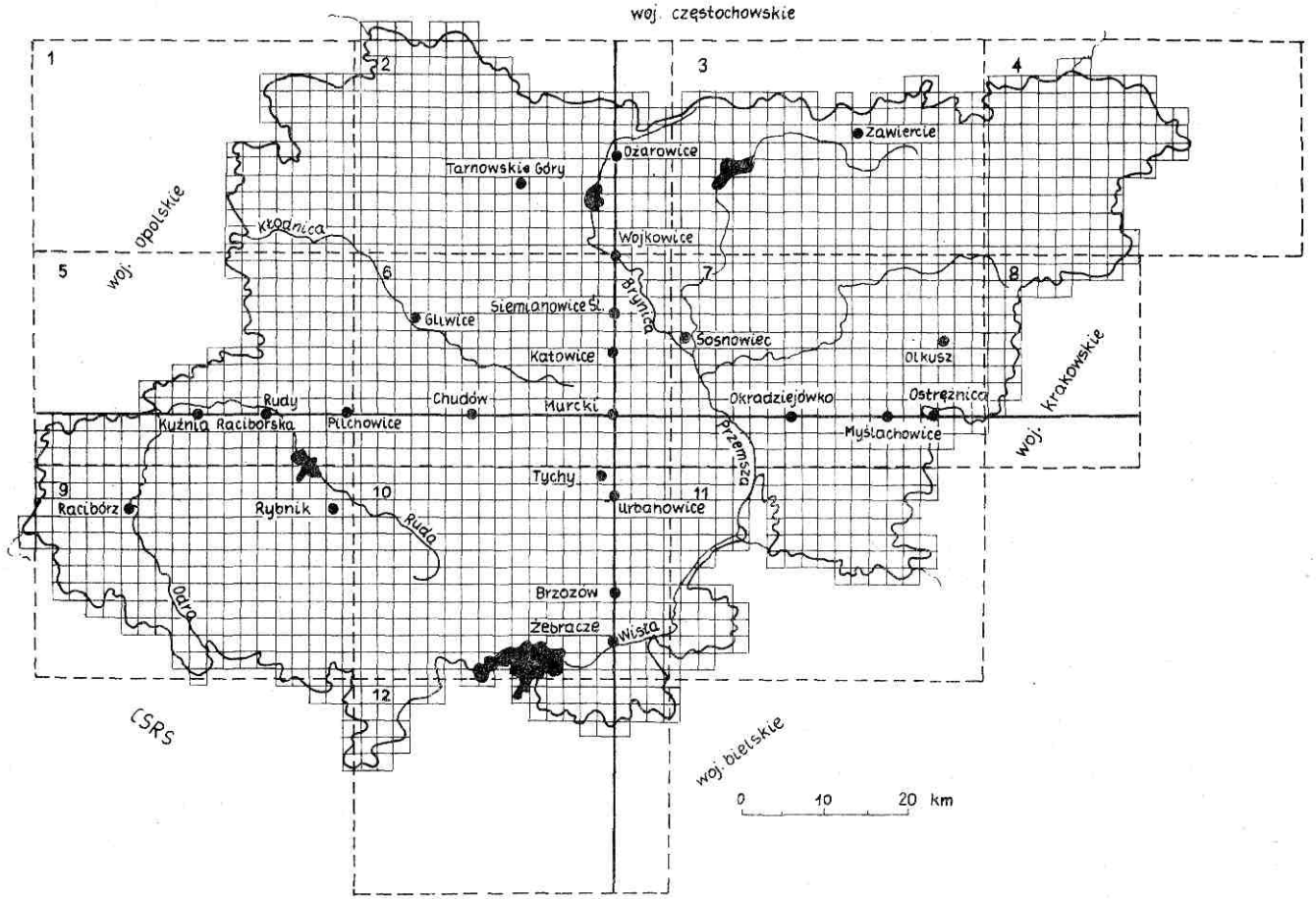

Fig. 1. The net of basic fields where indexes of anthropopression were determined:
thick lines — coordinate system, broken lines — the range of a sheet of the map of relief changes in Katowice province, 1, 2,... numbers of the sheets of the map

Rys. 1. Siatka pól podstawowych, w których określano wskaźniki antropopresji:
linie grube — układ współrzędnych, linie przerywane — zasięg poszczególnych arkuszy mapy przeobrażeń powierzchni ziemi województwa katowickiego, 1, 2, ... — numery poszczególnych arkuszy mapy

workings, 6 — workings left after open-cut coal mining, 7 — other workings

VI — subsidence:

1 — less than 1 metre, 2 — 1 to 5 metres, 3 — 5 to 10 metres, 4 — more than 10 metres

VII — mining areas:

0 — none, 1 — coal mining areas, 2 — mining areas of non-ferrous metals ores.

The first three indexes in the code, i.e. urban, industrial and afforested areas were encoded depending on the area they covered in the given field. These are rather stable elements and distinctive changes of the area they cover occur in slightly longer time periods. Taking into consideration their general tendency to increase the areas, the elements covered, were rounded up i.e. toward the larger value. Dumping grounds and workings, as the elements characterized by great intensity of changes of the covered area and cubature, were not encoded depending on their area. In this case only the information about their origin was given. While subsidence was analysed considering intensity of the process course (i.e. the depth of subsiding), and mining areas were only determined as existing or not in the given field.

Here is an example of a full coded notation in a basic field: 3 1 0 4 1 1 1, the digits have the following meaning: 3 — urban areas cover 3 km², 1 — industrial areas cover 1 km², 0 — no forests and tree stands, 4,5 — there are two types of dumping grounds: coal mining waste dumps (4) and power plant waste dumps, the former cover larger area, 1 — there are numerous minor workings there, 1,2 — subsidence occurs down to 1 metre and it covers larger area than the subsidence in the range 1 to 5 metres that also occures there, 1 — coal mining areas exist there.

All the data included in the *Code map of selected elements of geographical environment of Katowice province* have been obtained from the map of relief changes of Katowice province, prepared at a scale 1 : 50 000 by means of aerial photographs interpretation (Jankowski, Zieliński, 1990, p. 17—22).

CHARACTERISTICS OF ANALYSED INDEXES

1. Urban areas. Large concentration and constant increase of social-economic potential in a limited and relatively small area makes the province the most intensively urbanized region in Poland. The main centre of settlement is the urban complex of Upper Silesia Industrial Region (GOP), together with the eastern part of Western Industrial Re-

gion of Kraków which is connected with it. Industry plays a major role in this area. Toward the South-West the area of GOP is connected with Rybnik Coal Mining Area (ROW) that is currently developed. After enclosing the region of Racibórz into the province boundaries, the monostructural character of the region has been slightly changed. It tends to become a multi-branch industrial region but with a major role played by coal mining (Ż m u d a, 1981), 87.7% of the province population lives in 45 towns, 12 towns have more than 100 000 of inhabitants. The way of building, not only in urban but also in rural areas, is characterized by highly dense building development where most of the buildings are of multistorey and multi-flat type (fig. 2). The process of urbanization is continuous and shows increasing tendency. Urban-industrial landscape is neither rational in building development nor practically functional and esthetic. It is usually characterized by too many elements and industry-conducive phenomena, disorder in layout, coexistence of industrial complexes and housing estates and also disorder of natural structures of particular components of environment.

2. Industrial areas. A great part of the province area is covered by industry. They include factories and their close vicinity, which form technical background areas such as storage yards, stores and transport services areas (*The map of relief...*, 1982). Each year an area of grounds adapted for industrial purposes is increasing, which is caused by development of existing plants and construction of new ones. According to statistic data there were 2798 factories that belonged to industrial branch in Katowice province in 1985, which was 7.7% of the whole number of factories in the country. Such a large number of factories gathered in such a small area must have an influence on environment. Technical back-up facilities of factories, steel plants, mines, burdensome fumes, industrial sewage, and waste materials have extremely disadvantageous influence on environment. The highest concentration of industry occurs in GOP (fig. 3). There are also smaller in area industrial grounds in ROW and in the neighbourhood of Chrzanów, Czechowice-Dziedzice, Trzebinia, Zawiercie and Olkusz.

3. Afforested areas and tree stands. Forests cover 183400 ha in Katowice province that is 27.8% of the province area. There are mainly coniferous forests here, where a pine is the most popular. The forests are rather young, most of the trees are younger than 40 years. Distribution of forests is quite irregular. There are no larger forest complexes in the mostly urbanized areas i.e. GOP and in the South-West part of the province. Larger forests occur mainly along the borders of the province (fig. 4).

It must be mentioned that health conditions of the forests are determined as very bad. Forest stands are generally dwarfed and suffer from many diseases. It is caused by air, soil and water pollutions and also by

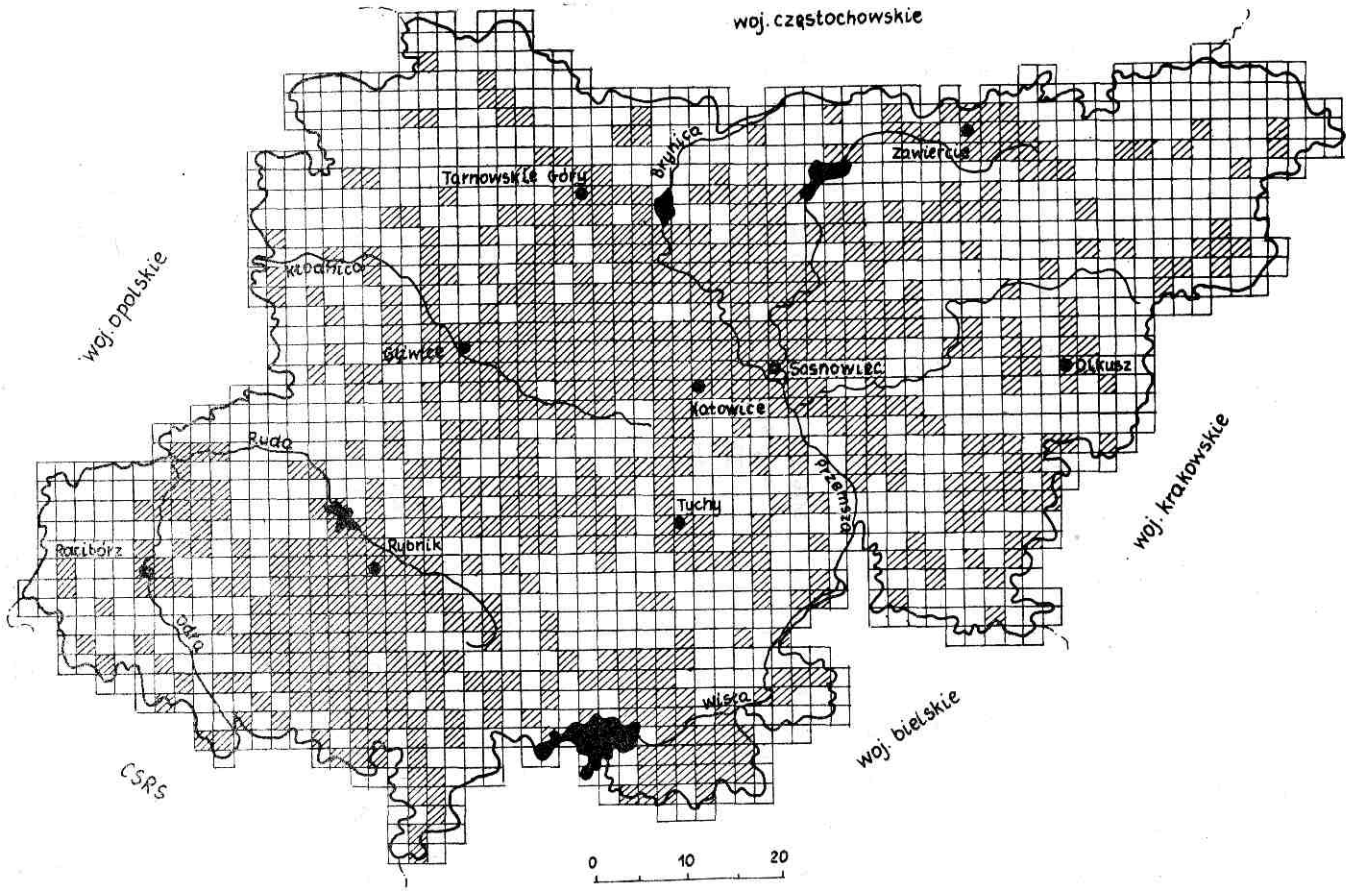

Fig. 2. Concentration of urban areas; marked are the fields where more than 1/4 of the area is urbanized

Rys. 2. Koncentracja terenów zurbanizowanych; uwzględnion**o** pola, w których co najmniej 1/4 powierzchni jest zurbanizowana

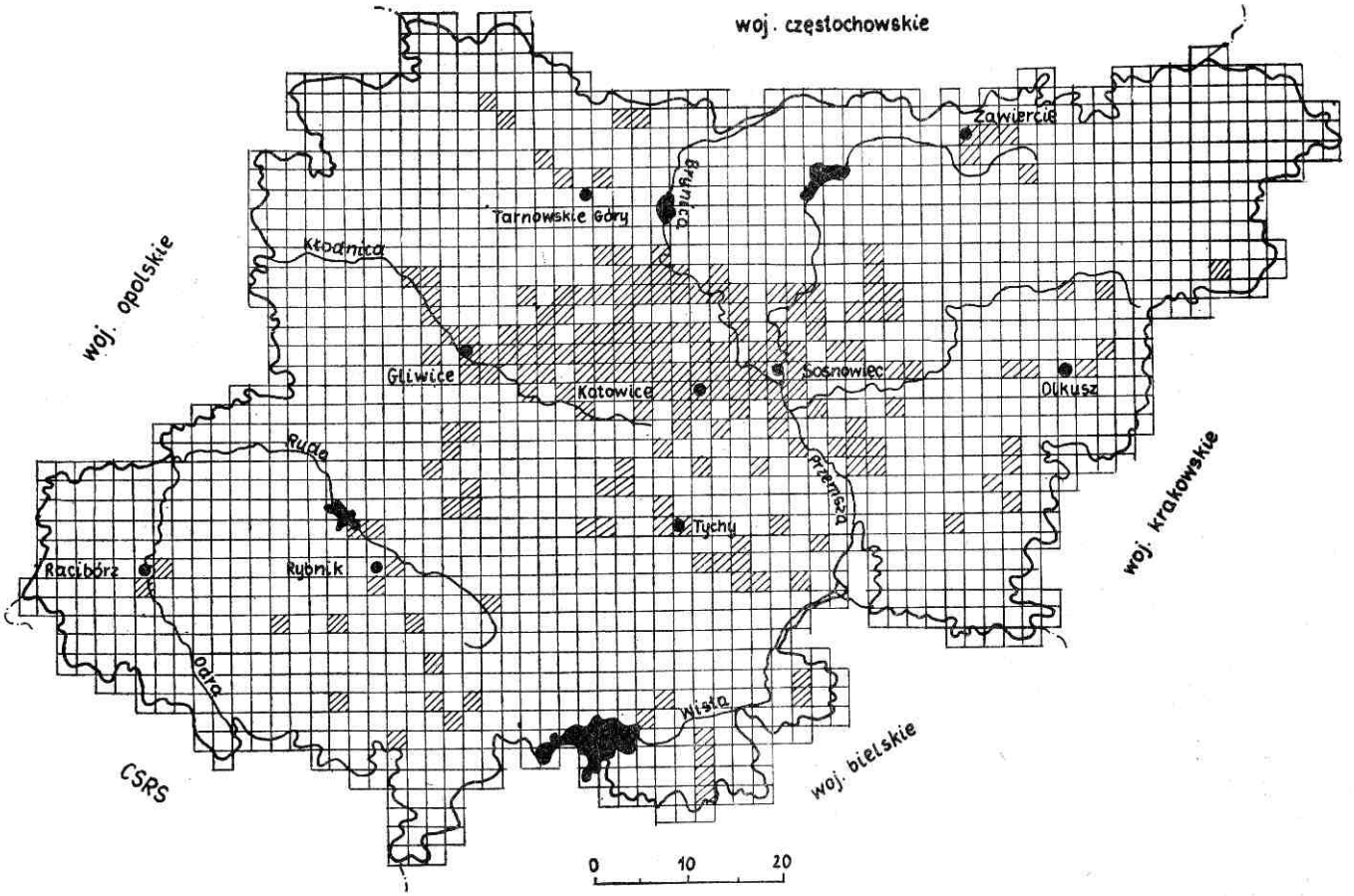

Fig. 3. Concentration of industrial areas; marked are the fields where more than 1/4 of the area is covered by industry

Rys. 3. Koncentracja terenów przemysłowych; uwzględniono pola, w których co najmniej 1/4 powierzchni zajmują tereny przemysłowe

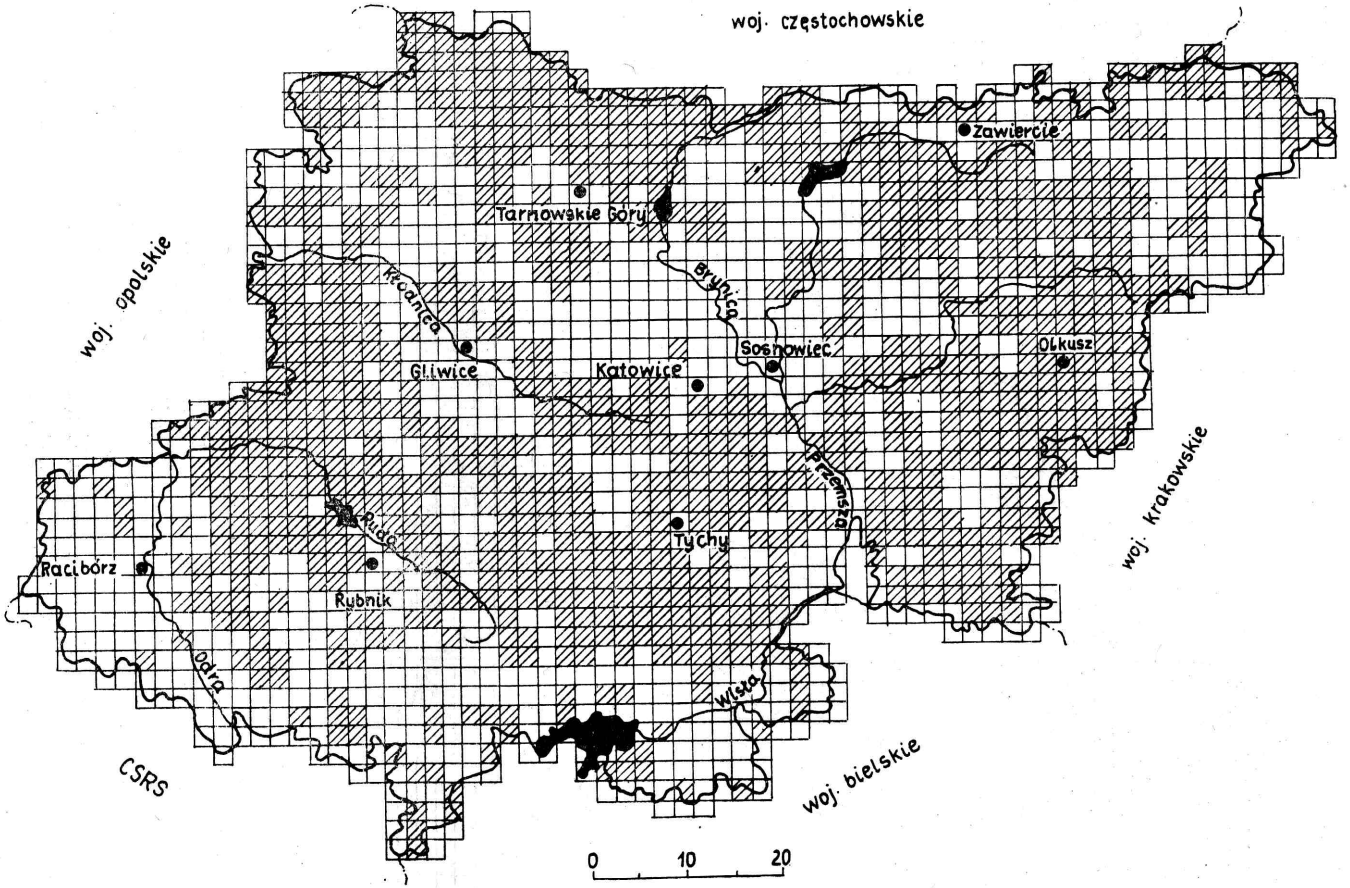

Fig. 4. Concentration of afforested areas and tree stands; marked are the fields where more than 1/4 of the area is afforested

Rys. 4. Koncentracja terenów zalesionych i zadrzewionych; uwzględniono pola, w których co najmniej 1/4 powierzchni jest zalesiona

subsidence. Long lasting pollutions result in smaller natural immunity of trees to diseases, in consequence their number decreases as well as the protective function of the whole formation.

4. Dumping grounds. Different types of dumping grounds are the most characteristic elements of the landscape of mining areas. Their development is connected with storing of different types of waste materials which are a by-product of raw materials mining and their processing in various branches of industry. Dumping of waste products was begun in Katowice province at the beginning of industrial development, so the time period of its influence on environment is sometimes longer than one hundred years. Some of the old dumping grounds have been recultivated, but still new ones appear and dumping grounds will be a problem untill we develop non-waste production processes.

There are various shapes of dumping grounds: cones, domes, ridges, flat and irregular. They also vary in area they cover. There are small forms but also dumping grounds covering large areas exist. As far as their height is concerned they are generally lower than 20 metres but sporadically also forms higher than 50 metres occure, mainly in ROW where they reach 80 metres in height.

Various materials are dumped in heaps depending on their origin. Mainly mining, metallurgical and power industry heaps occur. The following materials are dumped in mining heaps schists, mudstones, Carboniferous sandstones, slime admixtures, coal slurry, boiler slag and ashes. Power-plants heaps contain: fly-ash, smoke-box ash, slag. Metallurgical heaps contain blast furnace and boiler slags, ash and flotation residue. Particular branches share in "waste production" as follows: mining — 79.36%, metallurgy — 14.06%, power industry — 5.49% other branches — 1.09% (S z t e l a k, S z c z e p a ń s k i, 1983).

Most of the dumping grounds are situated in the central part of Katowice province, i.e. in the area covered by GOP and ROW (fig. 5).

5. Workings. Another anthropogenic form of relief, besides dumping grounds, is a working. Particularly large areas are covered by workings left after exploitation of filling sand. They cover the area from twenty — thirty ha up to several hundreds of hectares (eg. Szczakowa working). Workings left after exploitation of other raw materials seem to be relatively smaller and more scattered. Only cement industry workings form larger groups.

Workings appear in the whole area of the province however they are concentrated mainly in GOP and ROW (fig. 6). Some of the extremely large workings are recultivated. They are turned into agricultural- forest areas, adapted as leisure and recreation terrains, drowned forming water reservoires or used as terrains for special industrial building grounds, often used as dumping grounds.

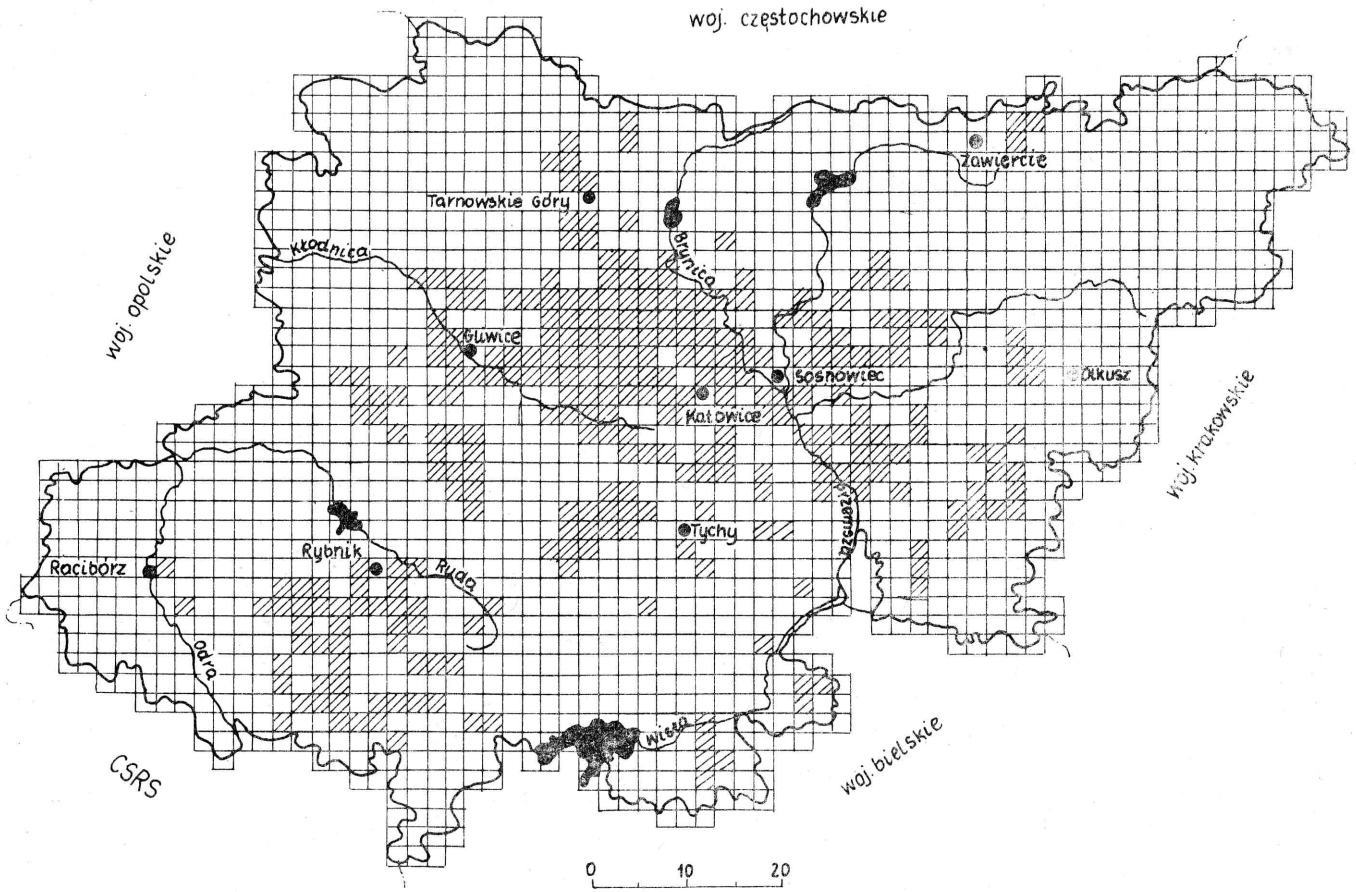

Fig. 5. Concentration of dumping grounds; marked are the fi elds where dumping grounds of different origin occur

Rys. 5. Koncentracja zwałowisk; zaznaczono pola, w których występują zwałowiska różnej genezy

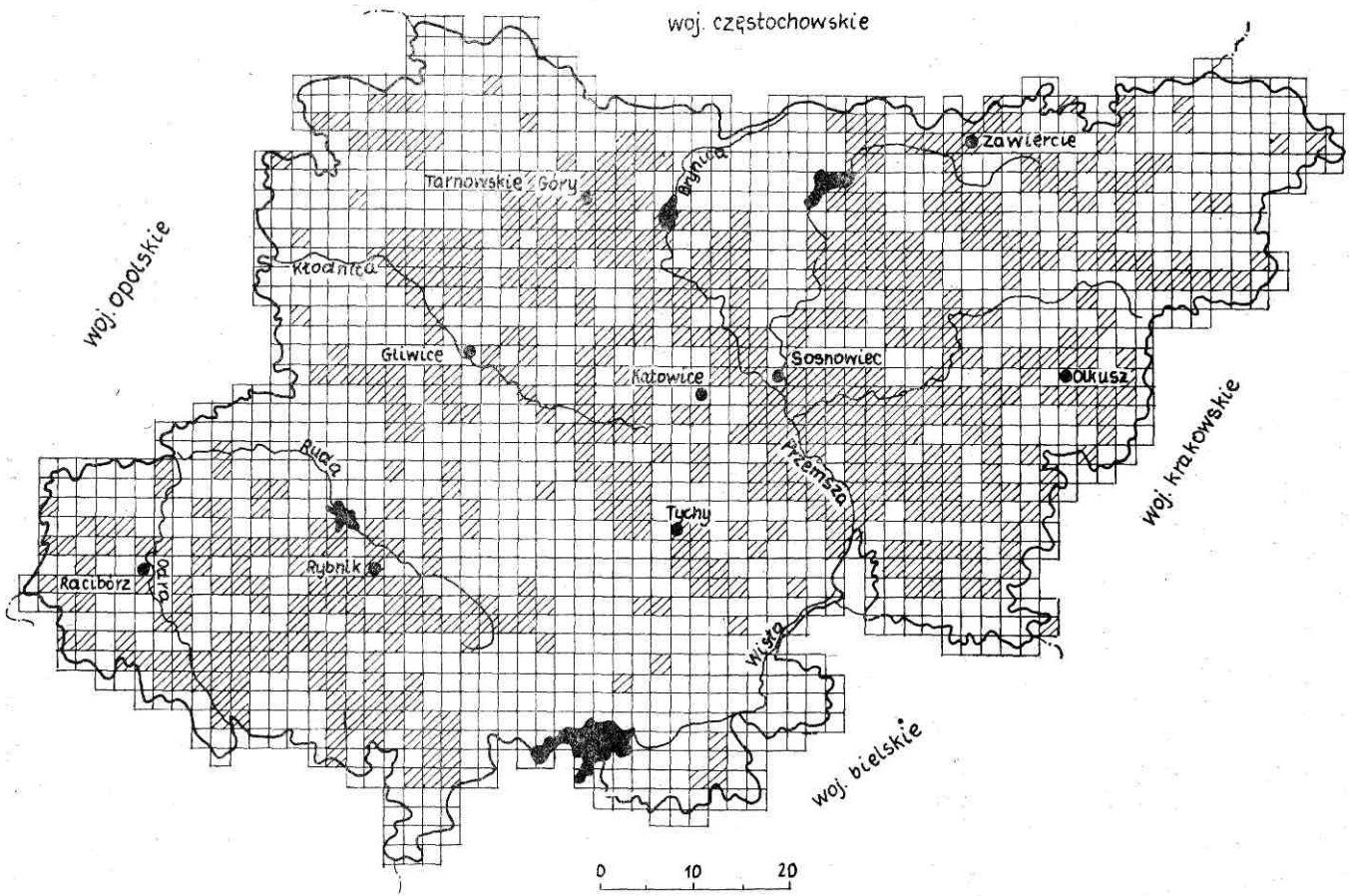

Fig. 6. Concentration of workings; marked are the fields where workings of different origin occur

Rys. 6. Koncentracja wyrobisk; zaznaczono pola, w których występują wyrobiska różnej genezy

6. Subsidence. Subsidence is connected mainly with underground mining using the break-down method and systematic continuous drainage of the massif. The areas of subsidence constantly increase in the province. The phenomenon is extremely intensive in coal mining basins: Upper Silesia and Rybnik (fig. 7). The results of coal mining and lead and zinc mining overlap in Bytom basin. The depth of ground subsidence reaches several metres in certain places (the region of Zabrze, Chorzów, Knurów or Jastrzębie).

J. Grzeszczak and M. W. Kraujalis (1972) suggest that formation and depth of a subsidence depends on thickness and the type of rocks that lie over an underground working and on thickness of the exploited layer, its depth under the surface and the system of exploitation. Sometimes subsidence is the result of mass movements such as: rock falls, land slides or rocks creeping. It usually occures when the natural geomorphology of the surface is differentiated and special geological predispositions to such movements occur. Water conditions are usually disturbed by the subsidence. Progressive subsiding of the terrain causes seeming rise of the underground water horizon which often results in drowning of the subsidence and formation of overflow lands (anthropogenic water reservoires).

7. Mining areas. Mining area is a place (terrain limits) where mining company is authorized to exploite particular minerals. It is assigned for a particular mine and it coveres such area that is necesary for rational exploitation of the deposit because of mining technique, safety and economy of exploitation. The most important is the fact that only one mine is authorized to excavate minerals within the given terrain limits.

Mining areas form large complexes in the central and southern part of the province (fig. 8). Obviously their spatial layout depends on localization of coal and non-ferrous metals ores deposits.

CONCENTRATION OF THE ANTHROPOGENIC CHANGES OF THE RELIEF

Six of the seven analysed indexes of anthropogenic changes of the relief in Katowice province really influence it. Afforested areas and tree stands, even in case of intentional planting, cannot change the relief. However they tend to preserve it. Therefore, only six indexes were taken into consideration when determining the concentration of the anthropogenic changes of the relief and the degree of intensity of the changes. These were: localization of urban and industrial areas, dumping grounds, workings subsidence and localization of mining areas. It was determined which of the six indexes occur in the given basic field. The field where 5 or 6 analysed indexes were found was recognized as the

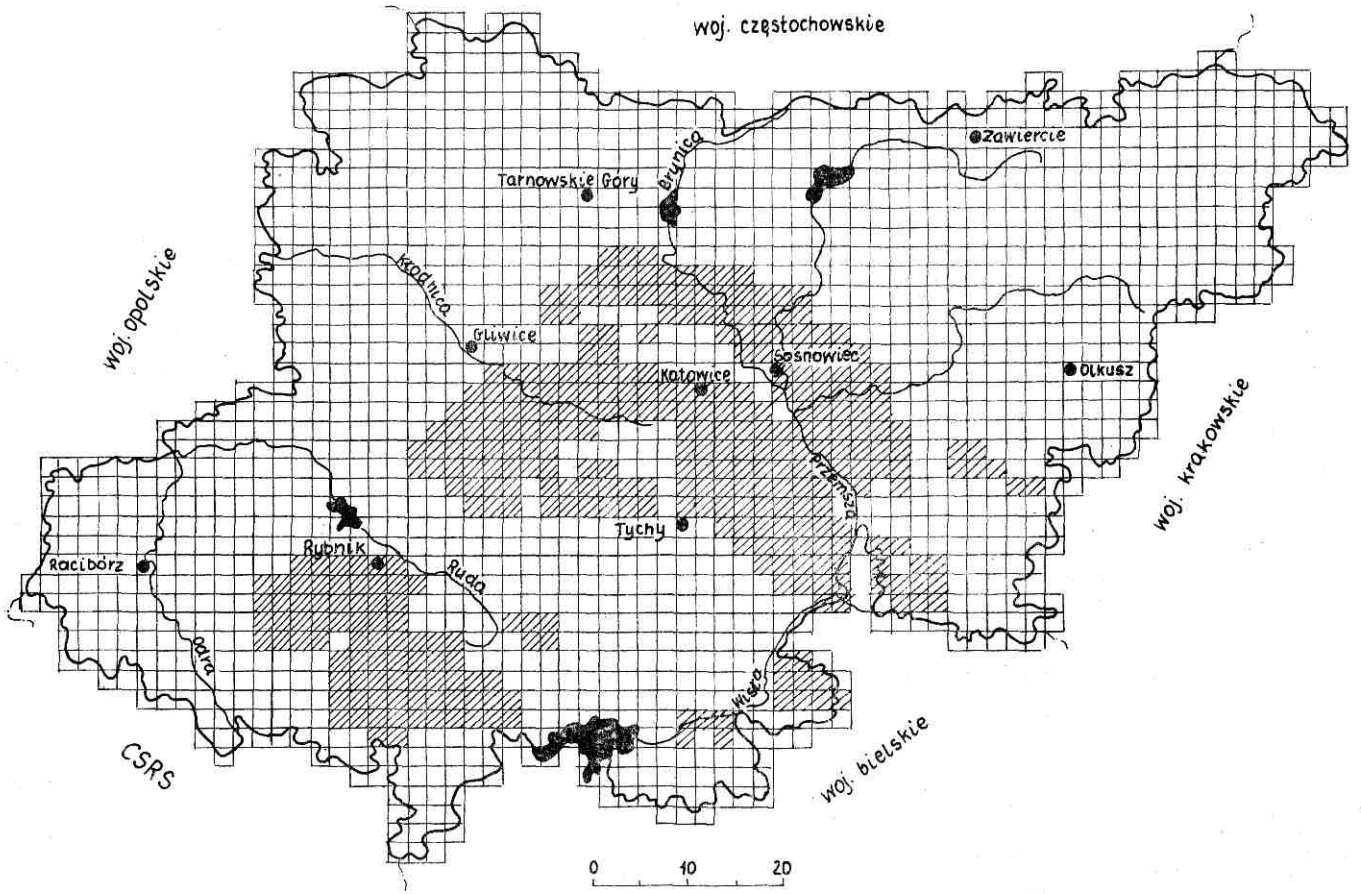

Fig. 7. Concentration of subsidence; marked are the fields where the process occurs

Rys. 7. Koncentracja osiadań terenu; zaznaczono pola, w których zachodzi proces osiadania terenu

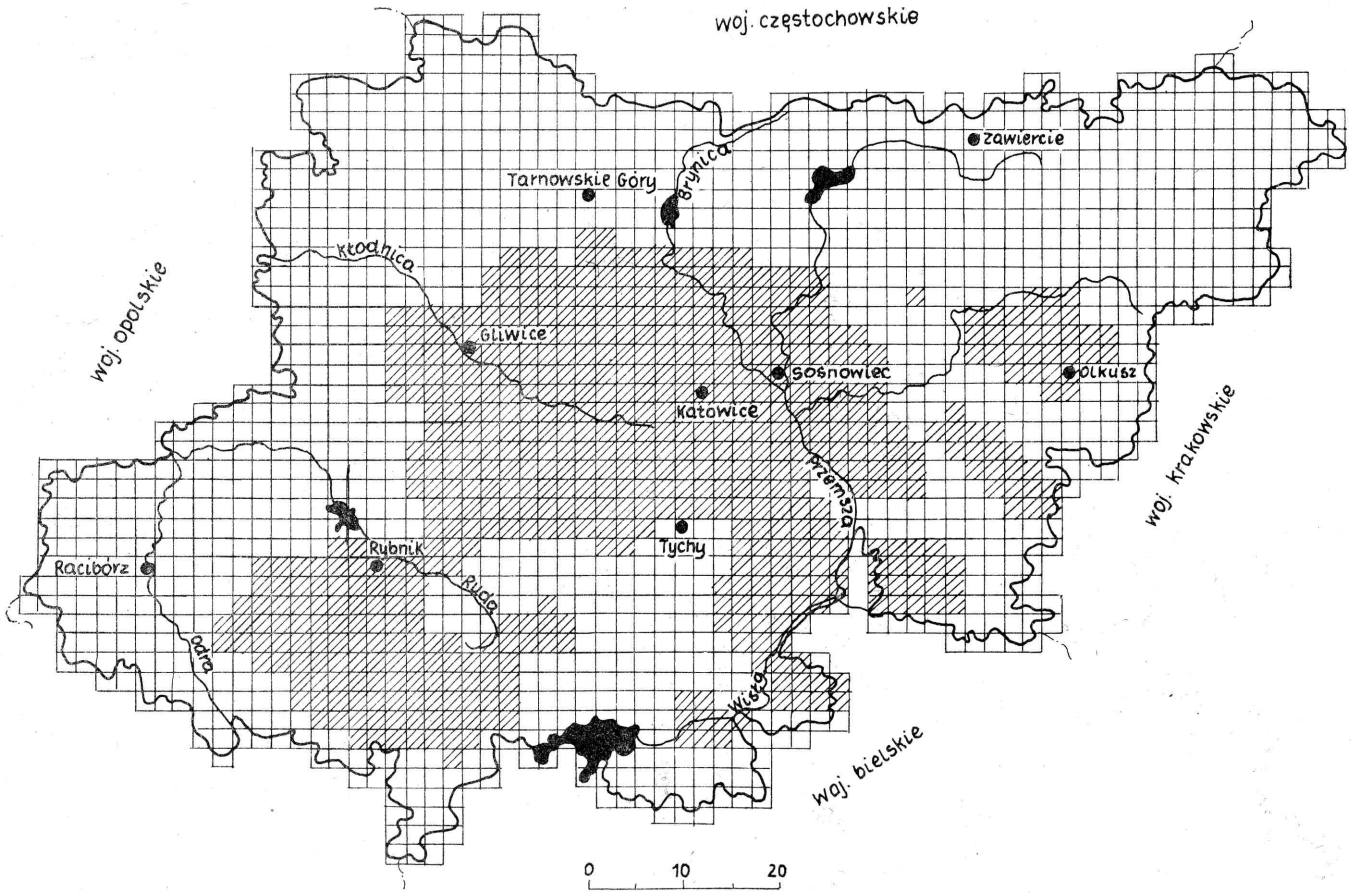

Fig. 8. Concentration of mining areas; marked are the fields where mining areas of coal and non ferrous metals ores occur

Rys. 8. Koncentracja obszarów górniczych kopalń; zaznaczono pola, w których występują obszary górnicze kopalń węgla kamiennego lub rud metali nieżelaznych

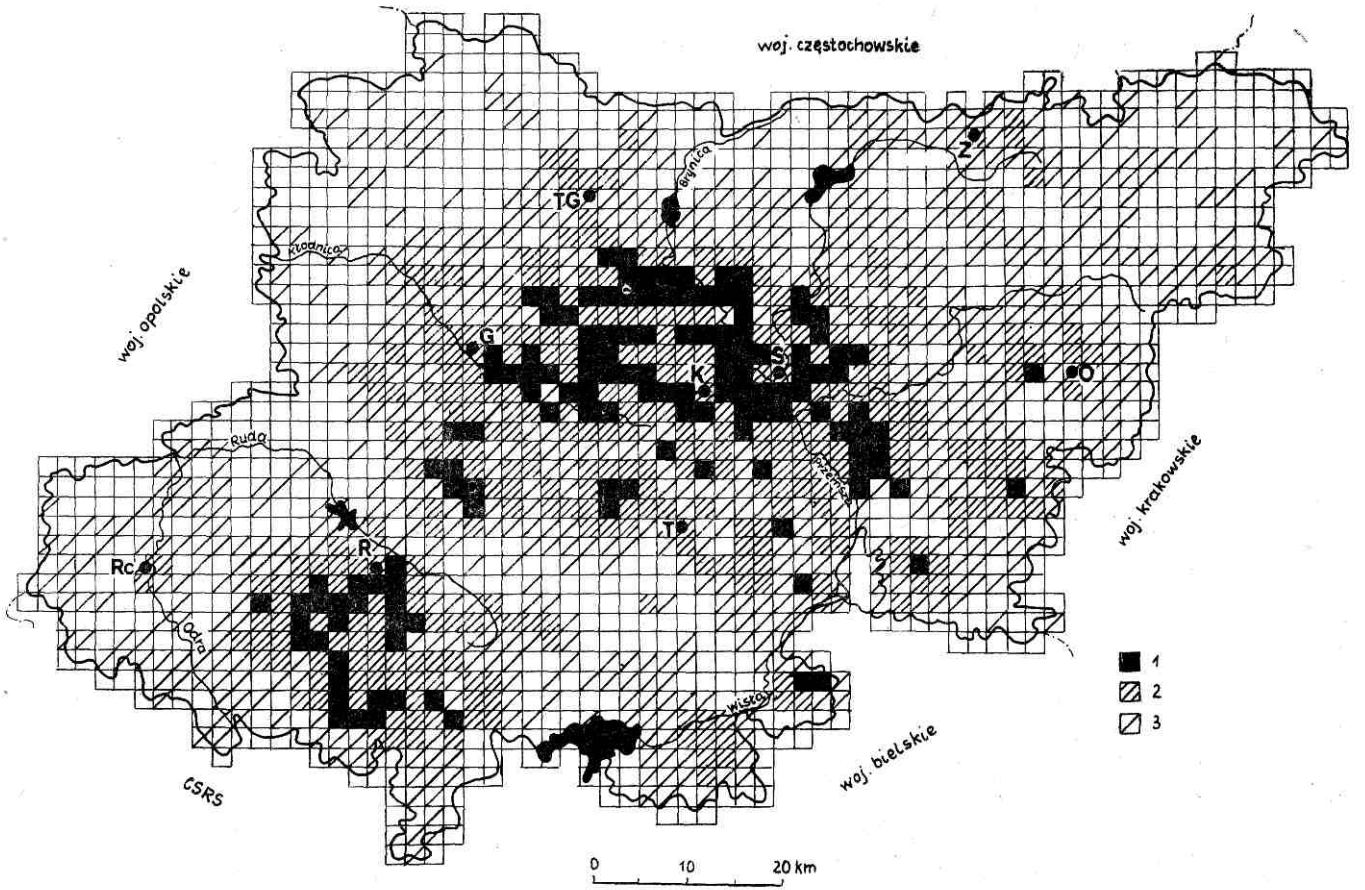

Fig. 9. Concentration of anthropogenic changes of the relief in Katowice province; a degree of the relief changes:
1 — very high (5 or 6 indexes of anthropopression), 2 — high (3 or 4 indexes occur), 3 — medium (1 or 2 indexes occur), white fields — no indexes of anthropopression, the relief is unchanged or slightly changed

Rys. 9. Koncentracja antropogenicznych przekształceń powierzchni terenu województwa katowickiego; stopień przekształcenia terenu:
1 — bardzo duży (występuje 5 lub 6 wskaźników antropopresji), 2 — duży (występują 3 lub 4 wskaźniki antropopresji), 3 — średni (występują 1 lub 2 wskaźniki antropopresji), pola białe — nie występują wskaźniki antropopresji, powierzchnia pola nie przekształcona lub nieznacznie przekształcona

place where the relief was the most intensively changed. The field where 3 or 4 indexes were found was recognized as the one characterized by the high degree of the relief changes and the field where 1 or 2 indexes occured was the one of medium degree of changes. The other fields were treated as terrains with the natural relief or the slightly changed relief. Obviously, road net and scattered village buildings also cause certain changes, however, they were not considered because such changes were not covered by the analysed map. Figure 9 shows spatial layout of the intensity degree of the anthropogenic changes of the relief. It proves that maximum changes are concentrated in two separate regions that are weakly connected together. These are Upper Silesia Industrial Region and Rybnik Coal Mining Area. These are the regions of the highest economic activity in the province which may be recognized as areas of "over concentration of industry". They are also apparent in satelite images as, different from the surrounding areas, photonal spots (Jankowski, 1986). Other components of the geographical environment in these areas are also characterized by intensive degradation. Therefore, purposeful activities to improve general ecological situation must be begun there as soon as possible.

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MAPA PRZEOBRAŻEŃ POWIERZCHNI ZIEMI WOJEWÓDZTWA KATOWICKIEGO CZĘŚĆ II: GŁÓWNE PRZEJAWY ANTROPOGENICZNYCH PRZEOBRAŻEŃ POWIERZCHNI TERENU

Streszczenie

W pracy przedstawiono tok postępowania podczas opracowania mapy kodowej wybranych elementów środowiska geograficznego województwa katowickiego, dla której podstawą była wyłącznie mapa przeobrażeń powierzchni ziemi województwa katowickiego, wykonana metodą interpretacji zdjęć lotniczych. Zasadniczym celem pracy jest pokazanie głównych przejawów antropogenicznych zmian rzeźby i ich przestrzennego rozmieszczenia. Obszar województwa pokryto siecią kwadratów o boku 2 km (polu 4 km^2), zwanych polami podstawowymi (rys. 1). W polach tych określano na podstawie mapy przeobrażeń powierzchni ziemi województwa katowickiego następujące wskaźniki: I — tereny zurbanizowane, II — tereny przemysłowe, III — tereny zalesione i zadrzewione, IV — zwałowiska, V — wyrobiska, VI — osiadania terenu, VII — obszary górnicze kopalń (rys. 2—8). Trzy pierwsze wskaźniki kodowano w zależności od zajmowanej powierzchni w danym polu. Zwałowiska, wyrobiska i obszary górnicze kopalń kodowano w zależności od pochodzenia i faktu ich występowania w polu, natomiast osiadania terenu analizowane były pod kątem intensywności przebiegu tego procesu. W ocenie koncentracji antropogenicznych przekształceń powierzchni terenu woj. katowickiego uwzględniono jedynie 6 analizowanych wskaźników, pominięto tereny zalesione i zadrzewione jako nie powodujące zmian rzeźby. Wydzielono 4 klasy zróżnicowanej intensywności antropogenicznego przekształcenia powierzchni terenu województwa (rys. 9). Stwierdzono, że maksymalne przekształcenia terenu koncentrują się w dwóch rejonach: Górnośląskim Okręgu Przemysłowym i Rybnickim Okręgu Węglowym.

РЕНАТА ДУЛИАС, АНДЖЕЙ Т. ЯНКОВСКИ

КАРТА ИЗМЕНЕНИЙ РЕЛЬЕФА КАТОВИЦКОГО ВОЕВОДСТВА Ч. II: ГЛАВНЫЕ ПРОЯВЛЕНИЯ АНТРОПОГЕННЫХ ИЗМЕНЕНИЙ РЕЛЬЕФА

Резюме

В работе представлен ход действия при составлении „Кодовой карты избранных элементов географической среды Катовицкого воеводства", основой которой была использована исключительно „Карта изменений рельефа Катовицкого воеводства", выполненная методом дешифрирования аэрофотоснимков. Главная цель работы — показать основные проявления атропогенных изменений рельефа и их пространственное размещение. Территория воеводства покрыта сетью квадратов со сторонами 2 км (поле 4 км^2), называемых основными полями (рис. 1). В этих полях на основе „Карты изменений рельефа Катовицкого воеводства" определялись следующие показатели: I — урбанизированные территории, II — промышленные территории, III — территории, покрытые лесом и деревьями, IV — отвалы, V — выработки, VI — оседания территории, VII — шахтные поля (рис. 2—8). Три первых показателя кодировались в зависимости

от занимаемой поверхности в данном поле. Отвалы, выработки и шахтные поля кодировались в зависимости от происхождения и факта их появления в поле, а оседания территории анализировались с точки зрения интенсивности протекания этого процесса. При оценке концентрации антропогенных изменений рельефа Катовицкого воеводства учитывались лишь 6 рассматриваемых показателей; не обсуждались территории, покрытые лесом и деревьями, так как они не вызывают изменений рельефа. Выделены 4 класса неоднородной интенсивности антропогенных изменений рельефа воеводства. Замечено, что максимальные изменения концентрируются в двух районах — Верхнесилезском промышленном округе и Рыбницком угольном бассейне.

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