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## CHOROPLETH MAP AND DIAGRAM MAP – ABOUT MERGING METHODS OF CARTOGRAPHIC PRESENTATION

**Abstract:** Various aspects of merging the chosen presentation methods (choropleth and diagram) on one map are discussed in the article. Attention is focused on the graphic match of both methods, on the character and reference of data presented in this manner. Examples of such matches are shown, from the simplest application to complicated anamorphic presentations.

**Key words:** cartographic presentation methods, choropleth map, diagram map.

### 1. INTRODUCTION

Presentation of data on maps requires the use of appropriate graphic instruments which will allow map users to read it. Depending on the scope of cartographic information, cartographers decide to use one, two or several presentation methods in the same map. The simultaneous use of the choropleth and diagram is an often used presentation method. This is probably the most popular merger. The example of *Atlas Rzeczpospolitej Polskiej* (Atlas of the Republic of Poland) [A2], in which these methods were simultaneously used in 23% of the maps as well as *Narodowy Atlas Polski* (National Atlas of Poland) [A1] in which these methods were used in 15% of the maps, testifies to this.

### 2. GRAPHIC MATCH

From the point of view of map graphics, the analysed merger of methods is undoubtedly very accurate. The choropleth method includes areas (geo-

metric or administrative), coloured according to a defined colour scale, and it is a method which constitutes the map's background. The diagram method, however, constitutes appropriately scaled diagrams in the first plan, with a choropleth in the background. Thus, the methods excellently merge with the each other without any disturbance.

### 3. DATA SELECTION

An indispensable condition for simultaneous application of these two methods is logical (and not accidental) selection of the presented data. Information presented in one map must be thematically related, create a new quality – transmit new data.

Data selection and the choice of a presentation method which will make possible a comprehensible presentation is unusually essential in cartography. According to K. A. Salishchev (1998), the main difference between a choropleth map and a diagram map rests in the character of the chosen data. Absolute data are generally applied to diagram maps and relative values to choropleth maps. During a more thorough study of literature, it turns out that the choice of a presentation method on the basis of the data character is not so simple and obvious. This has been confirmed in experimental research (J. Korycka-Skorupa, 2004). Cartographers rather have no doubts in regard to the relative values of choropleth maps (L. Ratajski, 1989; J. Paślawski, 2007) but the selection of data for diagram maps is not so unambiguously defined (L. Ratajski, 1989; M. Monmonier, 1996). Many cartographers allow applying both absolute and relative data values or do not raise the issue of data values in discussing the diagram map method (K. Kocimowski, J. Kwiatek, 1977; A. H. Robinson and al., 1995).

Four kinds of mergers were distinguished while taking into consideration the possible combinations of applying two kinds of data to two presentation methods (Table 1):

Table 1. Types of merger of choropleth and diagram maps according to data character

		Diagram method	
		absolute	relative
Choropleth method	relative	Type A	Type B
	absolute	Type C	Type D

### Type A: choropleth map – relative data values, diagram map – absolute data values

This is the most often applied merger and the closest to the opinions of cartographers. In *Atlas Rzeczypospolitej Polskiej* (*Atlas of the Republic of Poland*) [A2], it was applied in almost 80% of the maps (166) in which both presentation methods were merged (209) and in *Narodowy Atlas Polski* (*National Atlas of Poland*) [A1] – this is 64% of the maps (63 of 99).

*The Black Stork* (Fig. 1) from the *Atlas Rzeczypospolitej Polskiej* (*Atlas of the Republic of Poland*) [A2] is an example. A choropleth map with geometric reference areas was used to present the percentage change in the number of black storks in the years 1966–1982 while a diagram map – three classes presenting the number of breeding places.

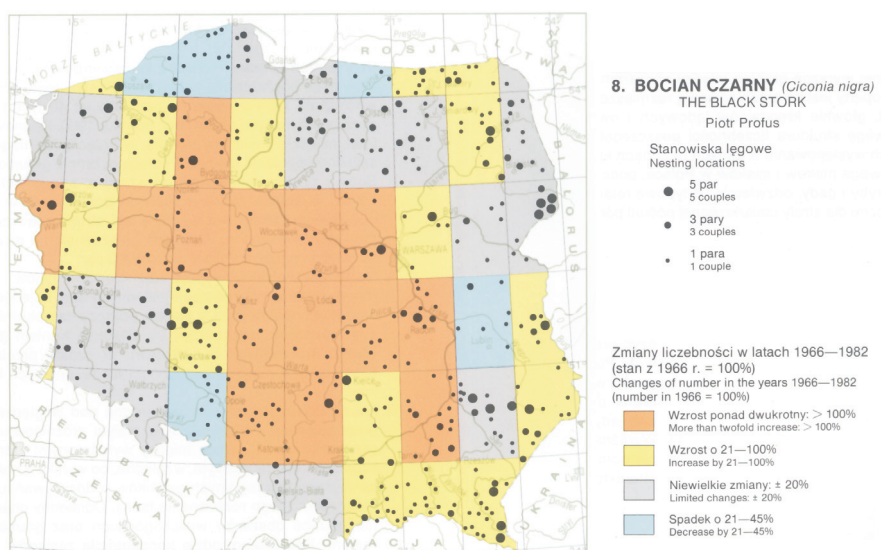


Fig. 1. The black stork [A2, graph 43.1]. Example of merging the two methods – type A.

### Type B: choropleth map and diagram map – relative data values

This is the next, relatively often encountered example of applying data on maps in which the discussed methods were merged. In *Narodowy Atlas Polski* (*National Atlas of Poland*) [A1] such a solution was applied in 34% of the maps and in *Atlas Rzeczypospolitej Polskiej* (*Atlas of the Republic of Poland*) [A2], in 20% of the maps. Many authors of the maps consider thus chosen data as being methodically correct which signifies that they accept applying relative data values to the choropleth map presentation. An example of this is a map entitled *Tractors and artificial fertilizers* (Fig. 2) in the

*Geograficzny Atlas Świata PPWK [A3]* (Geographic World Atlas). The use of artificial fertilizers in kg of pure components: nitrogen, phosphorus, potassium converted to 1 ha of arable land was presented in a choropleth map.

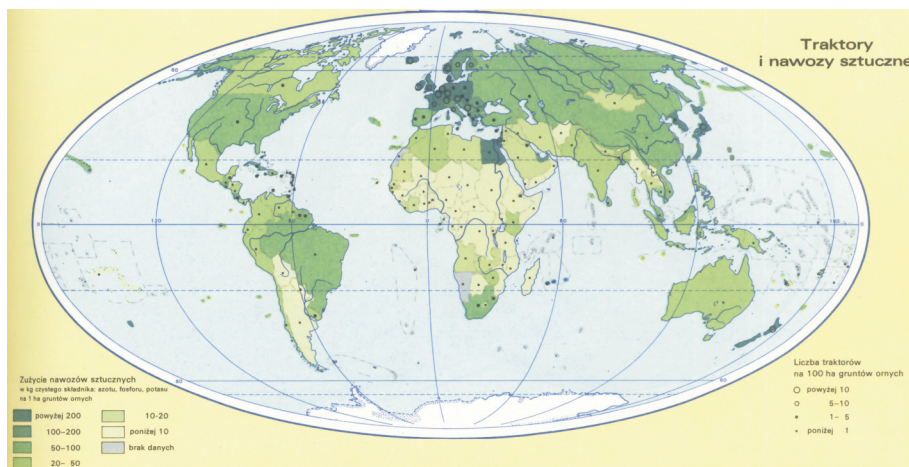


Fig. 2. Tractors and artificial fertilizers [A3, p. 27]. Example of merging two maps – type B

Unfortunately, a review of the maps proves that data selection is not always a well-thought through decision. One may find maps in which two different presentation methods: the choropleth method and diagram method are used to present data expressed in an identical manner. At that time, application of one method in two variants, e.g. a complex choropleth map in the case of relative data values or two types of diagrams for absolute data values, is a decisively better solution. It allows to avoid the impression that the map's editor totally accidentally chose both the data and the method.

### Type C: choropleth map and diagram map – absolute data values

Such a graphic solution seems incorrect because of the choropleth presentation of absolute data values. This is incorrect from the perspective of text book recommendations of the cartographic methodology. Absolute data values presented in different size areas make happen that map users initially view the size of the area (in this case, usually insignificant) and only later on the brightness of the area which is the essence of the choropleth method and gives information about attributing to a given area a phenomena of a specific class value. Application of absolute values is acceptable only in the case of a choropleth map with a geometric reference areas. Such choropleth maps, however, are used very rarely due to difficulties associated with gathering data in thus determined areas.

There are a few examples of such maps. In each of the Polish national atlases [A1, A2], there are only two. In figure 3 is shown a map entitled *Wykorzystanie turystycznych obiektów noclegowych* (Use of tourist accommodation facilities), derived from a school atlas [A6]. The number of people benefiting from tourist accommodation facilities is shown by using a choropleth method and a diagram method shows the number of foreign tourists using accommodation facilities with reference to their native country (structure).

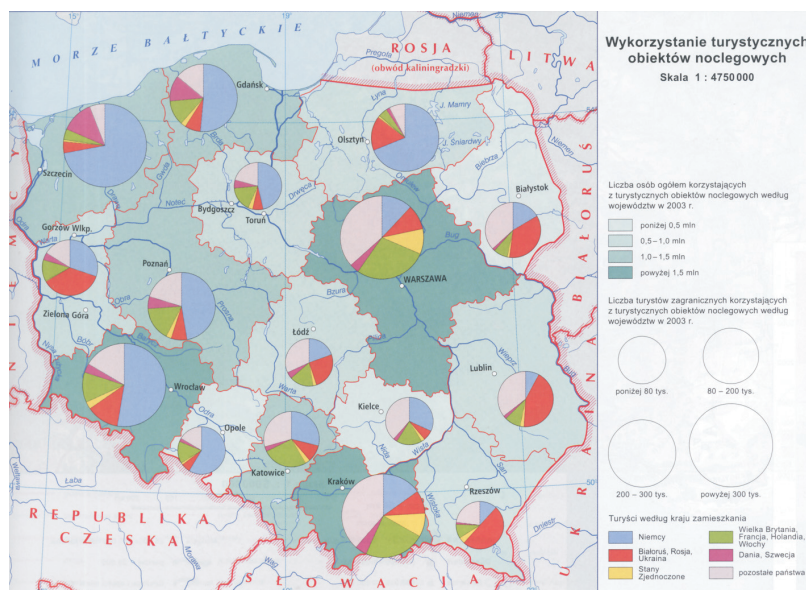


Fig. 3. Use of tourist accommodation facilities, [A6 p. 45]. An example of merging two methods – type C.

#### **Type D: diagram map – relative data values, choropleth map – absolute data values,**

Such a merger “negating” text book principles of cartographic methodology has not been used in any of the Polish national atlases.

#### **4. TYPES OF REFERENCE**

While analysing the merger of the choropleth and diagram methods in one map, it is worth while to not only look at the character of the applied data but also at their reference types. In the case of a choropleth map, data values are always attributed to plane units. Data used in diagram maps may be points, lines as well as planes. Therefore, it is possible to select the following types of graphic solutions (Table 2).

Table 2. Types of choropleth and diagram mergers with regard to reference types

	reference type	Diagram method		
		area	point	line
Choropleth method	area	Type I	Typ II	Type III

### Type I: choropleth and diagram – reference to area

Decidedly, this type of merger is the most frequent. It has been applied, among others, in the aforementioned figure 3. Both reference methods refer to the same area units and this absolutely facilitates map reading and its interpretation. These types of graphic measures should also include maps in which the discussed presentation methods refer to different (but area) spatial units. One of the few examples is presented in fig. 4.

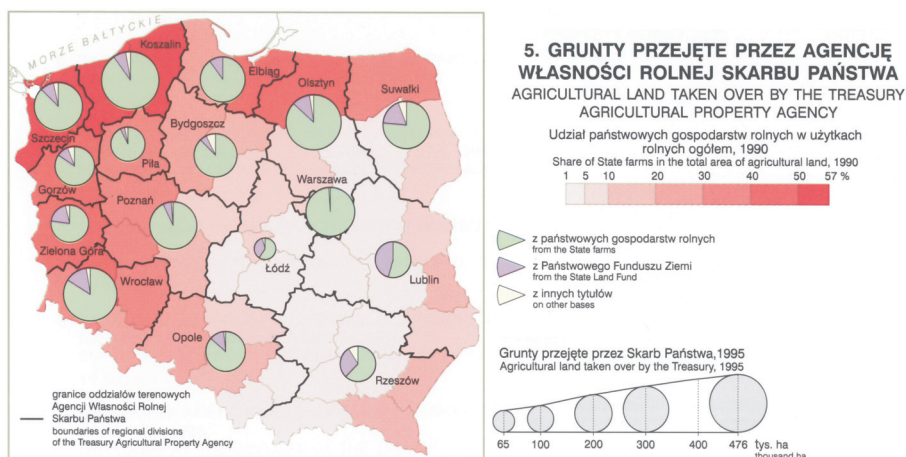


Fig. 4. Land taken over by Agencja Własności Rolnej Skarbu Państwa (State Treasury Agricultural Property Agency) [A2, graph 81.12]

Share of state-owned farms in the total farm land area (in reference to 49 provinces) is presented there in a diagram map. Circular graphs refer to other units: field branches of Agencja Własności Rolnej (Agricultural Property Agency). Such a merger, even though theoretically correct, is hard to comprehend by an average map user.



### Type II: choropleth map : reference to area, diagram map – reference to points

This type of merger is applied very often, especially in maps thematically associated with population and industry. In such cases, the choropleth method introduces various factors in reference to whole units: provinces, states, etc. Cities and industrial centres, for example, are shown by diagram method. Such an example is presented in figure 5. A choropleth method was used to show the share of municipal population in the general number of the country's population and a diagram method – the population number in chosen cities.

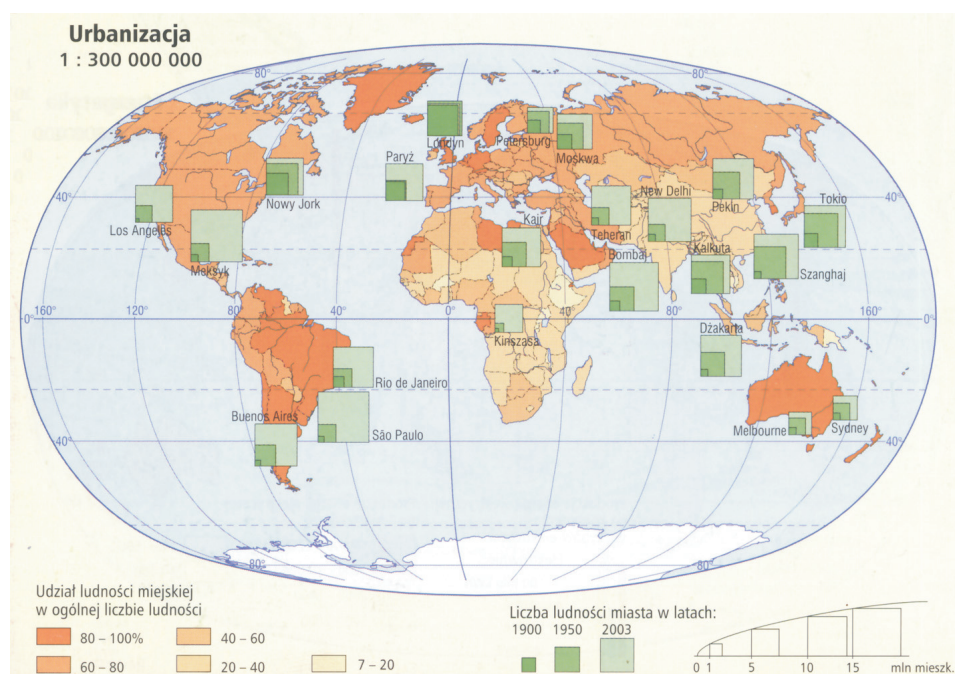
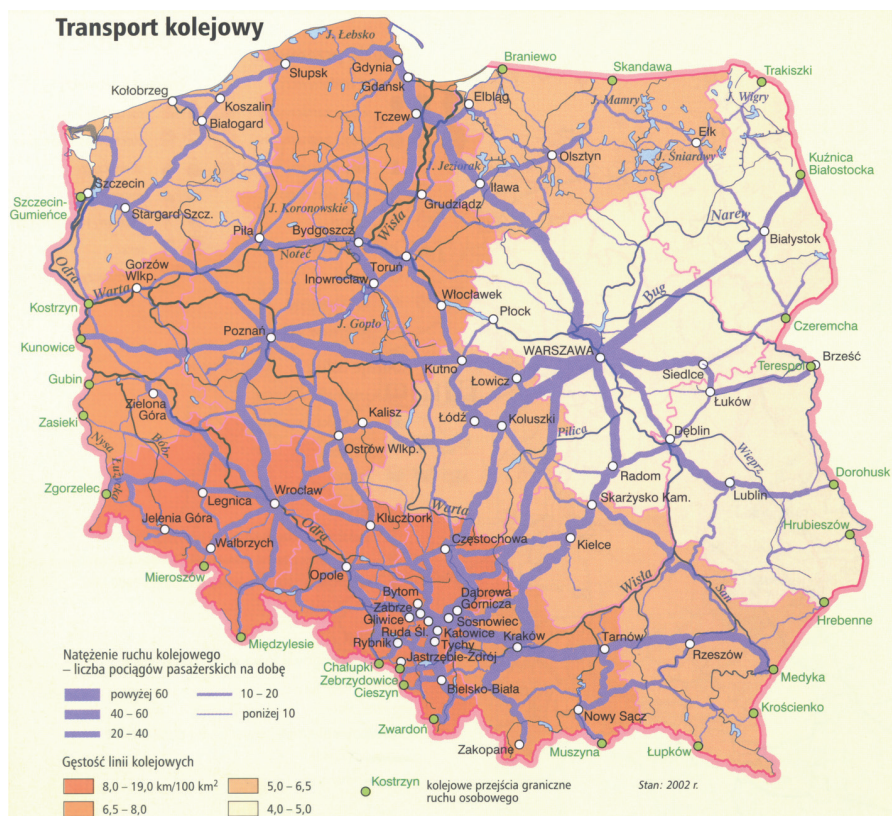


Fig. 5. *Urbanization* [A5, p. 22]

### Type III: choropleth map – reference to area, diagram map – reference to lines

This merger is quite universally applied, especially when there is a need to show movement or dislocation. An example is shown in fig. 6.

In the background, a choropleth method shows the thickness of railway lines expressed in km/100 km<sup>2</sup>. Provinces are the areas of reference. A linear diagram method was applied to show the intensity of railway movement expressed by the number of passenger trains per twenty four hours.

Fig. 6. *Railway transportation* [A5, p. 50]

## 5. THE SUBJECT OF MERGERS

The most often discussed merger of cartographic methods is used to show socio-economic issues. These problems require use of quantitative or ordered methods and among these, the most popular are choropleth and diagram maps.

The aspect of merging cartographic methods in maps should also be regarded through the prism of the discussed subjects. According to J. Wrona (2004), two phenomena may be shown in one map if they remain in a logical relation, if they complement and explain each other. Therefore, besides graphics, the character of data and their reference, thematic concurrence has unusual meaning. This, however, is a very subjective notion.

While looking at maps in atlases one may observe certain regularities. Data presented in maps by means of choropleth and diagram methods can be expressed in a similar manner. Then, a certain phenomenon is shown on a map by a choropleth and also the same phenomenon by a diagram but in



reference, for example, to the population number, surface or other element. In such a manner, it is possible to show, in one map, the population number and density, number of the unemployed and the unemployment rate.

Observing selection of the phenomena presented in maps it is also possible to draw the conclusion that the maps' authors decide to show similar phenomena, with a similar focus and variability or totally contrary phenomena. In the first case, such a presentation serves to emphasize the significance of a given subject. In the second, it aims at emphasising the contrast.

## 6. MERGER OF SEVERAL CHOROPLETHS AND DIAGRAMS INTO ONE MAP

Not rarely, a subject presented in a map is as broad as to require simultaneous application of numerous graphic variables. They may include several kinds of diagrams, a complex choropleth (two choropleths overlapping

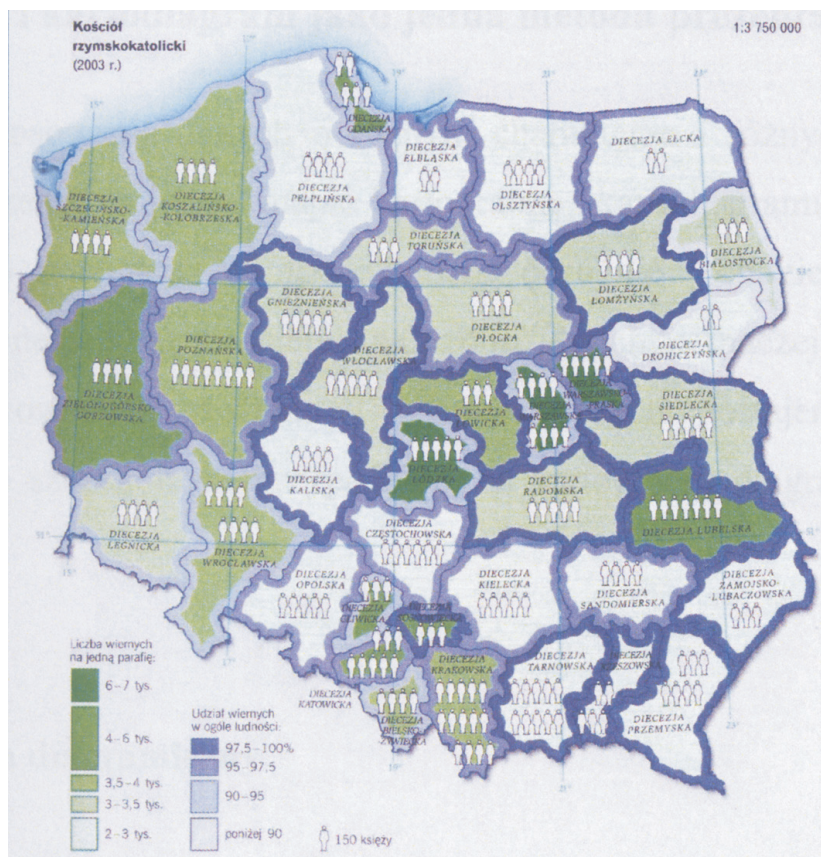


Fig. 7. The Roman Catholic Church [A7, p. 99]

each other), various kinds of signatures and other types of presentation (isolines, dots). It is not difficult to find a map in which, at the same time, are used several choropleths and diagrams. An example is presented in figure 7. The Roman Catholic Church is shown there from a very broad perspective. The number of faithful in one parish and the share of the faithful in the total population number are shown by two choropleths (one by brightness in the reference areas and the second by a colourful band in the perimeter of the reference area.

## 7. THE DIAGRAMMIC CHOROPLETH METHOD

The application of two methods on a map, i.e. the choropleth and the diagram, may have a somewhat different graphic form. It may not be a simple overlapping of two methods but rather an attempt to merge them, i.e. the so-called diagrammic choropleth. At that time, the choropleth is not presented in reference areas, e.g. communities or provinces, but in properly scaled diagrams. Thus, two phenomena which are closely related with each other may be presented, e.g. the number of schools and the number of pupils per one school – figure 8.

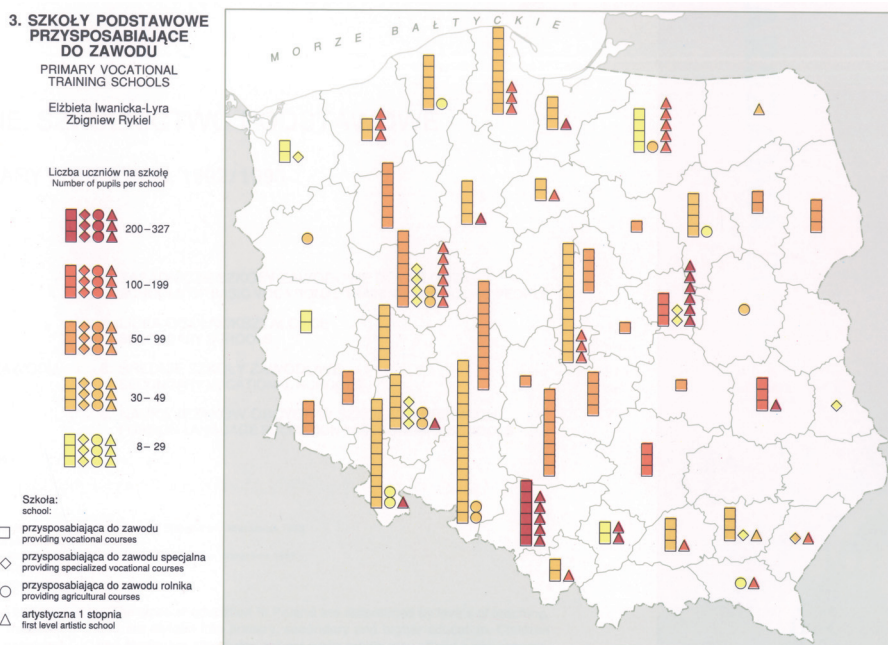


Fig. 8. Vocational training elementary schools [A2, graph 72.1]

Such an introduction requires concentration and greater attention on the part of a map user but it exempts him from searching for relationships between data. The map's editor alone „associates” data, shows the direction of interpretation to the map user. These two phenomena may be presented in one map by two „separate” methods. The map will be then easier to read but we are not sure that its user will be able to grasp the relationships between the phenomena.

## 8. THE ANAMORPHIC PRESENTATION

There still exists another method for merging a choropleth and a diagram in one map. This is a presentation which is the most graphically complex and the most difficult to interpret – the anamorphic presentation. Probably due to the aforementioned reasons, it is used very seldom. The basis is the anamorphic diagram (Fig. 9) in which the area of reference units is proportional to the size of the phenomenon.

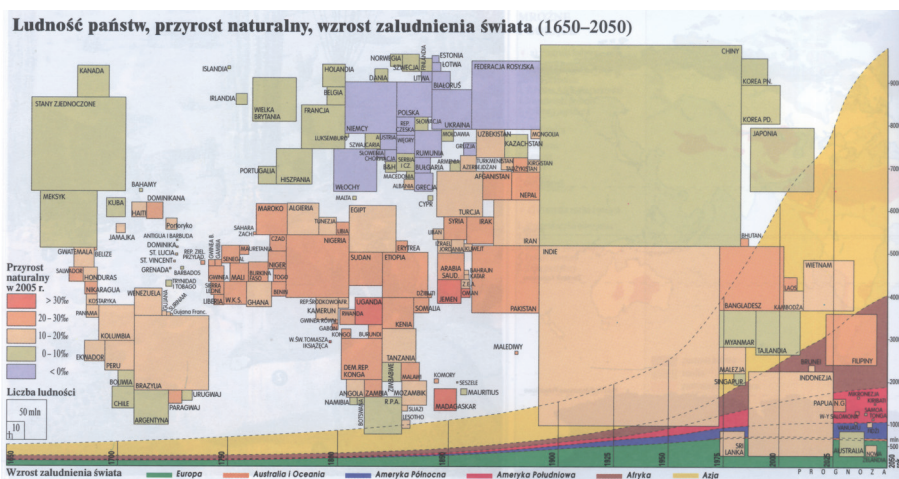


Fig. 9. Population of countries, population growth, growth of world population (1650-2050) [A4, p. 26]

The population of individual countries is presented in this manner in figure 9. Brightness, which characterizes the intensity of the phenomenon, e.g. population growth, was placed on the surface of these units, in accordance with the accepted colour scale. Analysing this method, a similarity to the diagrammatic choropleth may be observed. The difference is in the fact that in the diagrammatic choropleth, suitably scaled diagrams are placed in reference areas and in anamorphic presentations they „become” these areas.

## 9. SUMMARY

Every attempt to extensively and comprehensibly show chosen issues on a map requires the cartographer to use graphic instruments including, among others, a combination of cartographic methods. Merging a choropleth and a diagram may have various forms: from simple overlapping of two maps, by diagrammic choropleth up to complex anamorphic presentations. The legibility of such a presentation depends on the selection of data, their mutual adaptability, application of graphic instruments and also on the perception capabilities of the potential map users.

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*English translation: Małgorzata Miłaszewska*