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## The place of the “quantitative signature symbols” in the classification of the cartographic presentation methods

**Abstract.** The authors of the article pay their attention to the lack of a generally accepted classification of the cartographic presentation methods. The classification, which was described in the Ratajski’s handbook (1989) in the most extensive way, is commonly used in the Polish literature. According to the authors, it would be appropriate to modify one of the types of symbols (quantitative ones) as an independent method of data presentation at the quantitative level, in addition to the method of diagram, choropleth, dot method and isoline one.

**Keywords:** cartographic presentation methods, quantitative data

The problem of classification and systematization of the cartographic presentation forms, most often called the cartographic methods, is underestimated by cartographers. This is proved by the basic cartographical handbooks. Their authors either skip this issue or in different ways order the forms and methods of presentation, sometimes quoting the articles. This problem is clearly visible in the descriptions of GIS computer programs. Due to the lack of terms clearly defined by cartographers, the creativity of IT professionals in this area is enormous. This is also reflected in the translations of user guides, among others in Polish. Just browse through the most widely used GIS programs (ArcGIS, MapInfo, QGIS, GeoMedia) to see that the terminology, which is used in these programs, is ambiguous and inaccurate. Even the cartographers who translate the foreign textbooks and articles encounter serious difficulties in this regard.

The problem of the lack of ordering in the cartographical terminology in the scope of the methods of presentation was pointed out more than 40 years ago by prof. S. Pietkiewicz (1971), who was a participant in the works on *The multilingual dictionary of technical terms in cartography* (1972). The serious discrepancies in determining the term “cartogram” (435.1), which were only partially succeeded in removing in

the edited dictionary, drew the Professor’s attention. Ultimately, the dictionary in terms of terminology in the field of thematic cartography and thus in the methods of presentation shows the serious shortcomings.

The terminological matters are not explained sufficiently clearly in English in the dictionary elaborated by H.M. Wallis and A.H. Robinson (1987), to some extent, that is due to the lack of illustrations. In the textbooks, which are currently used, the authors either cite the polemical articles or avoid the explicit classification at all. Very often the discussion on the cartographic presentation methods comes down to the quotation of the types of maps (W. Witt 1973; J. Bertin 1973; F. J. Monkhouse, H.R. Wilkinson 1971).

The statisticians were bothered by that problem already in the second half of the 19th century, as they discussed during the statistical congresses not only the classification of graphical methods, but also their standardization (I. Kretschmer 1989). It seems that the discussions at that time did not affect the later works of cartographers in that regard.

In the handbook written by A. H. Robinson (1953), which had been the principal study at the academic level in the English linguistic area for half a century, there is no clearly classification in the scope of cartographic presentation

methods. Also, the authors of the currently used handbook (T.A. Slocum et al. 2005), did not feel a need of the explicit systematization, although they discussed the basic quantitative methods very broadly: diagram method, dot method, choropleth and isoline ones.

By reviewing the Polish textbooks, we can find out that their permanent content is a systematic discussion of the cartographic presentation methods, divided into the qualitative and quantitative methods. The first one who gave such a classification in Polish literature was J. Szaflarski (1955). On the basis of his extensive manual (591 pages) one may think that he used Soviet literature of that time. Here we can recall that N.N. Baranskij (1939), one of the editors of the excellent cartographical work of the time, namely of the "Great Soviet Atlas of the World", and the lecturer of economic cartography at the Moscow University, had published a script, expanded later, just before the war, with his classification. This classification was popularized by the Soviet authors, among others, by K. A. Sališev and A.W. Gedymin (1955), as well as N.N. Baranskij and A.I. Preobraženskij (1962). In Polish literature the scheme of classification derived from N.N. Barański was also fortified by two editions of L. Ratajski's hand-

book *Metodyka kartografii społeczno-gospodarczej* (The methodology of socio-economic cartography, 1974, 1989), a significant extension of earlier textbook prepared together with B. Winid and titled *Kartografia ekonomiczna* (The economic cartography, 1960, 1963). This classification was also used in the publications of the Central Statistical Office: in the textbook written by K. Kocimowski and J. Kwiatek from 1977, as well as in the latest paper written by M. Pieniżek and M. Zych (2016). This classification is also included in the textbook prepared at the Department of Cartography of the University of Warsaw under the editorship of J. Paślawski (2006, 2010). It seems that the attempts to verify, justify and extend the classifications published in our literature (W. Ostrowski 1984, W. Żyszkowska 2000, J. Korycka-Skorupa 2002, J. Paślawski 2005, 2009) did not lead to a wider discussion among cartographers.

The most common basis for the classification is the division into qualitative and quantitative methods. The distinction at the first glance is understandable, but it turned out to be insufficient to diversify the presentation methods used on the maps. The scarcity of such an approach became apparent when in the next

Table 1. "Table of the properties of cartographic methods" (according to L. Ratajski and B. Winid 1963)

Cartographic presentation method	Qualitative	Quantitative conceptions				Graphic form		
		absolute		relative		point	line	area
		continuous	interval	continuous	interval			
<b>Diagram method</b> point area line		■		■		■		
<b>Choropleth method</b> simple structural grided				■	■			■
<b>Dasymetric method</b>								■
<b>Dot method</b>		■				■		
<b>Signature method</b> qualitative quantitative	■		■		■	■		
<b>Range method</b>	■							
<b>Chorochromatic method</b>	■							
<b>Isoline method</b>			■		■			■

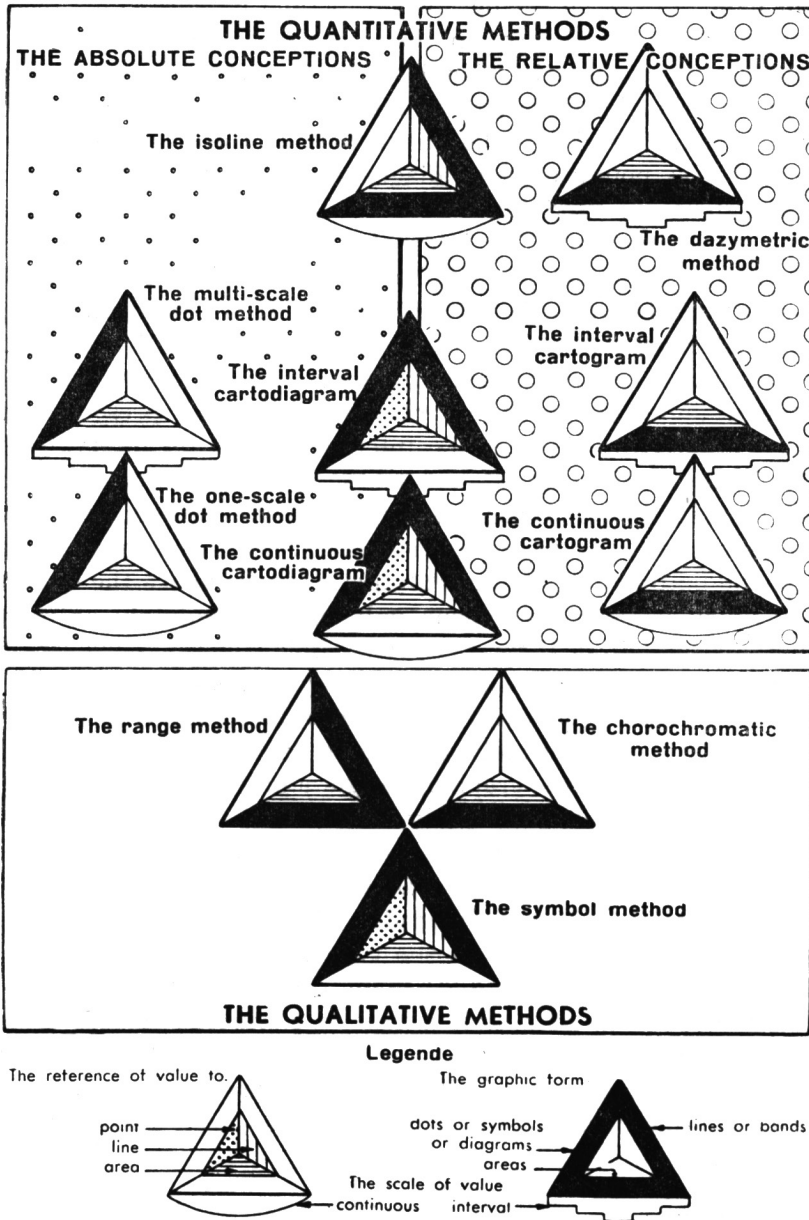


Fig. 1. Model of cartographic presentation methods (according to L. Ratajski 1968)

edition of his American handbook from 1969, *Elements of cartography*, A.H. Robinson along with R. D. Sale introduced the measuring scales according to S.S. Stevens (pp. 98–101). This was reflected in three figures, where the quality/quantity division had been replaced by

three measurement levels. The concept of measuring scales is now widely used in science, and it is based on mathematical operations that can be performed correctly by using different measuring scales. The encountered attempts to "improve" it by cartographers do not

seem to be convincing, and even in the handbooks there are also erroneous explanations of the individual measurement levels.

The introduction of this concept made the cartographers to be aware of, among others, the fact that there was no place for the methods of presentation on the ordinal level (e.g. small, medium, large industrial centres) in the classification scheme. Currently, for the clarity of classification, the ordering methods are distinguished independently (J. Korycka-Skorupa 2002) or included in the quantitative frames. This situation seems less comfortable for cartographers, especially in the context of hitherto habits.

In Polish literature, the term “quantitative signature symbols” (sygnatury ilościowe) appeared for the first time in the handbook by L. Ratajski and B. Winid published in 1960 and mentioned above. Also in the second edition of 1963 we can find a similar passage, and the third chapter “The methods of economic cartography” precedes the short introduction with a reference to the “Table of the properties of cartographic methods” (table 1), where “quantitative signature symbols” are placed. This table was published unchanged in a slightly later doctoral dissertation by L. Ratajski (1965). Probably the table mentioned above was the inspiration for the development of a graphical model of methods discussed in English first (L. Ratajski

quantitative and qualitative methods. As you can see at the illustration, the model does not take into account the “quantitative signature symbols”.

The most commonly cited example of the discussed “quantitative signature symbols” is the indication of a size of the cities on the general reference maps (fig. 2) or on the other maps of population. These signs were formed on the basis of markings the cities, which had been already used on the oldest cartographical messages. On the maps of Ptolemy’s “Geography” all the cities are marked with a small circle, filled with brown color. Later, the cities were designated in more functional terms (seat of prevailing, bishop’s seat, seat of court). Since the beginning of the relevant statistical data, i.e. from the first half of the nineteenth century, the classification criterion indicating the importance of cities has become the number of inhabitants. Because it would be impractical to operate with the already-familiar diagrams having the surface area proportional to the statistical data, the symbols creating the systems that indicate the classes of a size of the cities were introduced. The classification of statistical data (standardized data) is a basic procedure used in cartography resulting from a graphical function, that generalizes an image to show general distribution, size or tendency. To reflect the relationships of a sequence of classes (not



Fig. 2. Symbols on the general reference maps

1968), (fig. 1), and subsequently published in both editions of the above mentioned handbook *Metodyka kartografii społeczno-gospodarczej* (The methodology of socio-economic cartography) (L. Ratajski 1973, 1989). The basis for the creation of this model is the division into

the relationships of size), the variations of size and pattern were used, combining in one character the graphical variations of shape, value and texture. In the adopted system, the size of the characters changes with the statistical values, but this is a variance that does not correspond

to these statistical quantities. Just every next character is a bit bigger, visually “heavier”, more visible to a map user. The final form of such a system depends on the author’s ability and ingenious. The aim is to develop an efficient system of signs, the elements of which would be clearly legible and indicate the location of individual cities in the adopted classification system.

Figure 3 shows the graphic “relationship” of the “quantitative signature symbols” to the range

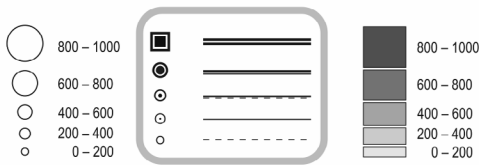


Fig. 3. Graphical similarity of “quantitative signature symbols” to graduated diagrams and choropleth method (own elaboration)

for the choropleth method or isolines, not for the “quantitative signature symbols”, but the sizes of cities, the limits of which are usually “round”, are adopted for their designation. According to L. Ratajski (1989), these classes are defined as normative ones, corresponding to the substantive classifications prepared by the specialists in the field. E. Imhof (1972, pp. 71–72) wrote that “the quantitative signature symbols create an embryonic form of diagram” (*Die Zahlenwertsignaturen ... bilden gleichsam eine embryonale Entwicklungsform des Zahlenwertdiagrammes*). It can also be written that the “quantitative signature symbols” are the degraded diagrams, and this “degradation” of magnitude is compensated for the perceptual reasons by the internal variation of a sign. The similarity to a choropleth is based on the graphical loading of a sign, which corresponds to the cartographical brightness, which is the basis of the choropleth mapping. In the textbook of L. Ratajski and B. Winid (1960, p.112) we read

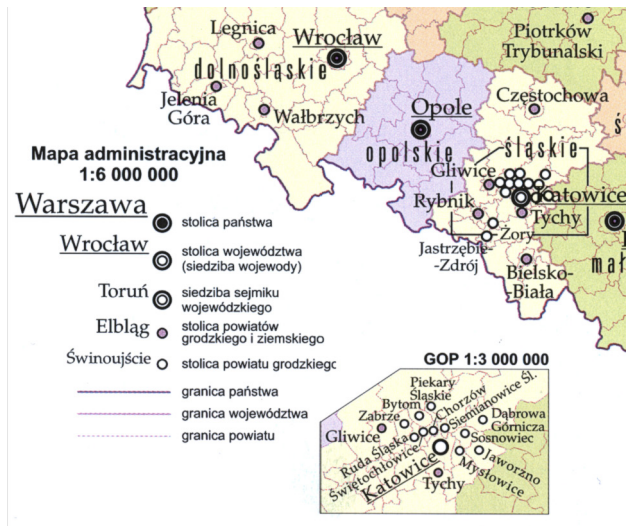


Fig. 4. Symbols of order used to show the administrative functions of towns

diagrams and the choropleth map. They combine the changing size of a character with the diagrams, while with the choropleth – its brightness, expressed by the using of an optical weight. The “quantitative signature symbols” present the data in the classes. The methods of determining the series of classes are used

“... a quantitative signature symbol is like a choropleth related to a point”. The task connected with the filling of a sign should make an impression that it is “heavier” optically, and therefore more important than the previous one. Lech Ratajski (1989, p. 83) used the term writing about the “optical weight” and “optical aggres-

**elektrownie  
wiatrowe o mocy:**



Fig. 5. "Quantitative signature symbols" used to demonstrate the wind power plants

siveness" of the sign. It can therefore be stated that the "quantitative signature symbols", where the only variance of size is used, are the graphical solutions that are very close to gradu-

this form of presentation to the signs belonging to this classification, an independent qualitative method, even as an exception, is a clearly unfortunate solution.

The graphical form in the textbooks is usually illustrated with a sequence of the city-size signs used on the general reference geographical maps (fig. 2). It also happens that the signatures do not show a size, but an importance of the cities, so they are ordered according to their functions (fig. 4). Besides the most common use of the "quantitative signature symbols" connected with the "population", the use of them with respect to the points is used relatively rarely (figs. 5, 6, 7).

It should be noted that the "quantitative signature symbols" with a line reference are also used. Here are the examples of transport maps,

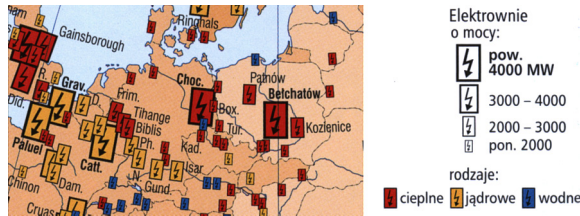


Fig. 6. "Quantitative signature symbols" used to show the power of thermal, nuclear, and hydroelectric plants

ated symbols, in which it is sometimes difficult to say whether the size of a character for each class is directly proportional to the value of the phenomenon or not. Likewise, with the graduated pictorial diagrams, where this proportionality cannot be stated.

It is difficult, however, to find in practice the examples of the "quantitative signature symbols" used to show the phenomena other than the population, in which more graphical variables (and not just the size) are used. Adding

**Wielkość portów lotniczych**

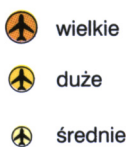


Fig. 7. "Ordered signature symbols" used to show medium, big and great airports

as, like in the case of numerical data for cities, maintaining the relation of magnitude according to the principles of linear diagram construction may be impossible and can be replaced with the ordinal terms, e.g. large, medium, small. Examples of linear signatures at the level of order may be a designation of river water quality classes (fig. 8) or road classification (fig. 9). According to the convention of using quality symbols, the "quantitative signature symbols" discussed here may also have a surface reference (fig. 10).

The uniqueness of classification of the "quantitative signature symbols" in Polish studies is that the method called signature method is included into the qualitative form, according to S.S. Stevens, it is located at the nominal level. The introduction of an exception at this level, which is undoubtedly placed at a higher level of measurement, namely at the ratio level, possibly interval, and therefore at the level traditionally referred to quantitatively, must be regarded



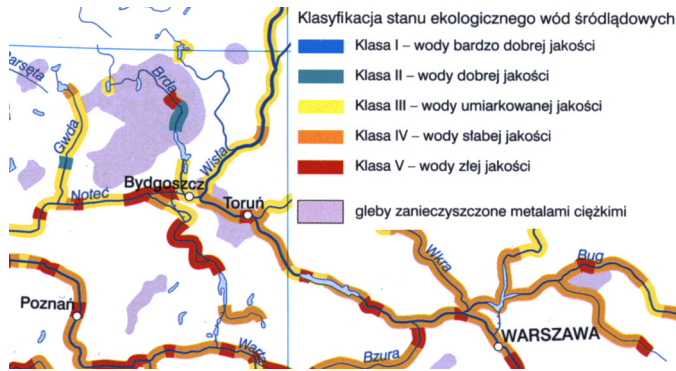


Fig. 8. Linear ordered symbols used to show the classes of river’s water quality

as a classification error. It seems that the terminology of this graphical form was influenced by the graphical form, that is, the similarity of the signs to the symbols at the nominal (qualitative) level, and the similarity of the symbols to the points, lines and, as we mentioned above, also to the area.

Kategorie dróg

- autostrady
- - - autostrady w budowie
- drogi ekspresowe
- drogi główne
- drogi drugorzędne

Fig. 9. Linear symbols used to show the categories of roads

Conclusions

Accepting the point of view presented in this article, we should assume that we operate with five forms of presentation, which we place at the “quantitative” level, i.e. the level of order, interval, and ratio:

- diagram map,
- choropleth map,
- isoline map,
- dot map,
- quantitative signature symbols.

On the margin of the above considerations concerning the systematization of cartographic presentation methods and forms of presentation one should pay attention to the lack of generally accepted classification, especially terminology.

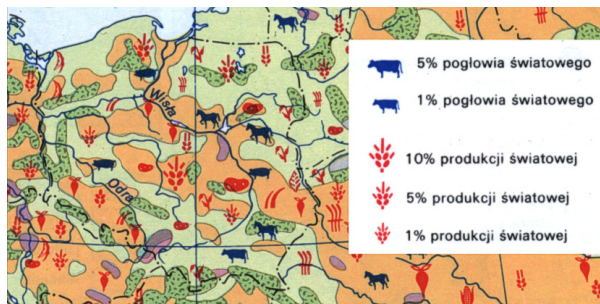


Fig. 10. Areal “quantitative signature symbols” used to show crop and animal production

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