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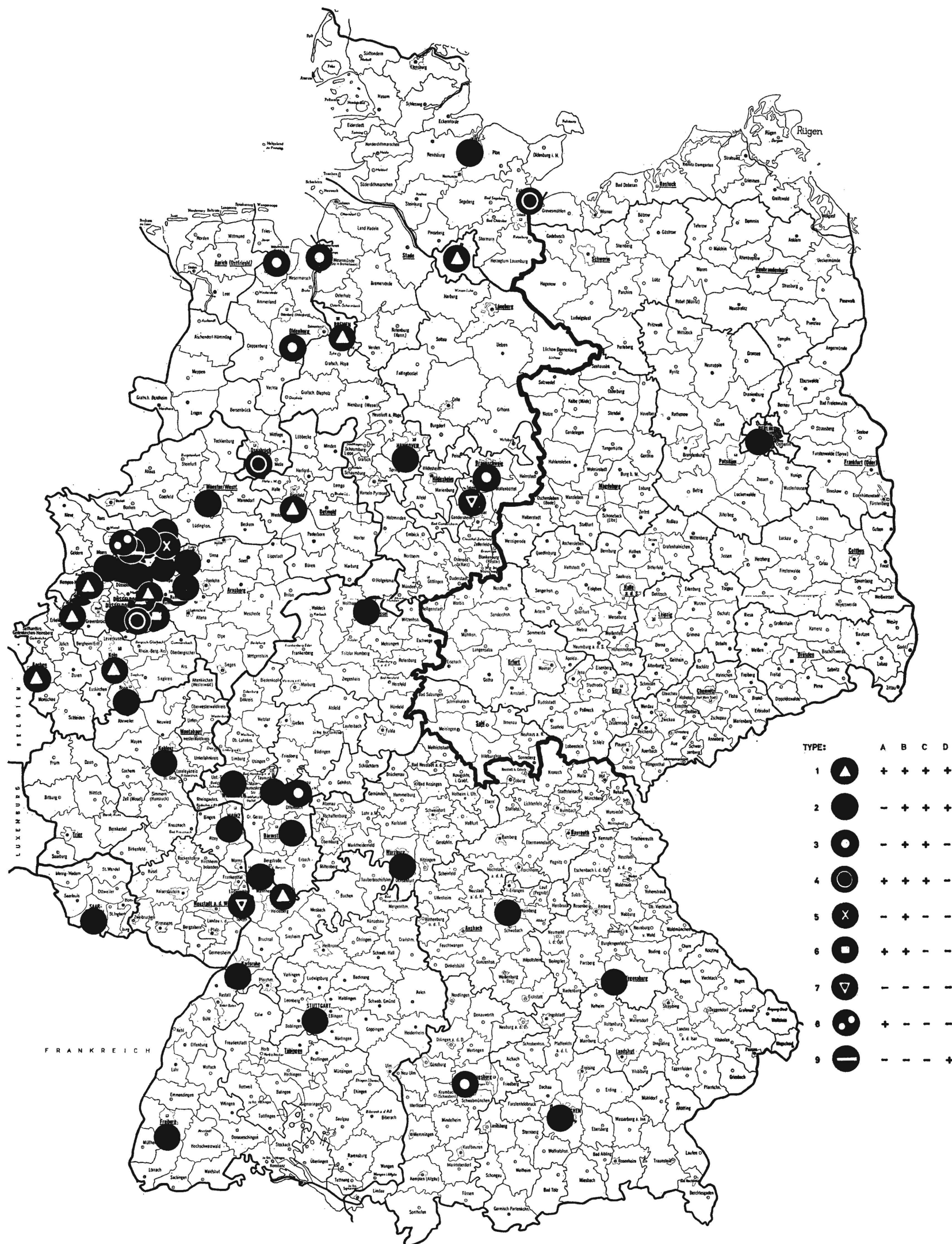


FIG. 1
RETAIL CENTRALITY AND EFFICIENCY OF TOWNS WITH MORE THAN
100 000 INHABITANTS IN THE GERMAN FEDERAL REPUBLIC

SOURCE: CENSUS OF COMMERCE 1960

+ = OVER AVERAGE OF THE STATE
 - = UNDER

A = SHOPS PER 1000 INHABITANTS
 B = RETAIL-EMPLOYEES PER 1000 INHABITANTS
 C = SALES PER INHABITANT
 D = SALES PER RETAIL-EMPLOYEE

ON A METHOD FOR ANALYZING RETAIL CENTRALITY AND EFFICIENCY IN TOWN- AND REGIONAL PLANNING

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INTRODUCTION

Urban core studies are studies concerned with a great deal of data material. As the borders of the core are changing permanently, it is difficult now, and will be in future too, always to get recent data. Even if these data should have been collected according to a grid—or a block-system—, it still will be the question, if the changes in land-and floor-use can be kept up to date.

In any case, great quantities of data have to be evaluated in urban core studies, and there is a danger to come to deductions out of the situation of the one core, neglecting its interrelation to other cores and other communities in the region. As the required size (sq. km.) of a core and the number and level of central functions are influenced by number, size, and level of the centres existing in the surroundings, this interrelation, however, is important. These surroundings may be the region, the whole country, or, in special cases, they may reach over the borders of a state.

In an investigation of the Ruhr-area ¹⁾ such data problems had to be solved. Task of the investigation was to find location, size, and number of future sub-centers. These centres should promote new concentrations outside the existing cores and offer location for activities, which move out of the cores. As size, number, and location of the new centres have to be adapted to the size of the core and the size and location of the already existing sub-centres, an analysis had to be made about the whole area. Because there were a great number of districts (400) and communities, about which information was needed, a simple ratio method has been developed additional to the hierarchical pattern of the absolute values, to measure further regularities and laws in the distribution of functions.

The investigation was concentrated on the retail-sector. Later researches showed, that retail centrality and retail structure of a community or a district is a reflection of the situation of the whole unit. If there are structural inequalities in the economic base (monostructured areas), they will be reflected in the retail structure ²⁾.

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¹⁾ Gerhard Curdes, Jürgen Müller-Trudrung: Untersuchung zur Förderung von Nebenzentren im Ruhrgebiet. Institut Gewerbebetriebe im Städtebau, Köln, 1966.

²⁾ Curdes, Müller-Trudrung: op. cit., p. 91 foll.

THE METHOD

The following data were available for communities and statistical districts:

1. number of retail shops 1959
2. number of retail employees 1959
3. retail sales 1959.

Out of the material, two kinds of ratios may be deduced:

I. Ratios applied to inhabitants

1. shops per inhabitant
2. employees per inhabitant
3. sales per inhabitant.

II. Ratios applied to shops

1. employees per shop
2. sales per shop
3. sales per employee.

A set of four ratios has been combined:

- A. shops per inhabitant
- B. employees per inhabitant
- C. sales per inhabitant
- D. sales per employee.

If a threshold-value is used to measure the highness of the ratios, by “+” or “—” can be shown for each ratio, if it is over or under this mark. Threshold-values can be: Goal-values, minimum-values, maximum-values, and average-values. Four ratios with two possible values for each make sixteen combinations. Out of these, some do not appear at all, some appear seldom, and some more frequently. Generalizing, one might say: “+” indicates stronger, “—” weaker or not existing central trade-functions. This statement is possible, as a regression analysis showed the following high coefficient of determination:

	Communities	Statistical Districts
Population: Retail Employees	r^2 0,97	r^2 0,89
Population: Retail Sales	r^2 0,97	r^2 0,89

By the combination of four ratios, trade structures of a similar type can be isolated, as the threshold means a condition for each of the four categories.

As threshold-value for the analysis of the Ruhr-area a corrected average-value of Nordrhein-Westfalen, for the analysis of the cities in the GFR the average-value of the Republic has been used.

Each combination of “+” and “—”, which differs from another combination, will be called “type”. The types will be shown on the bottom of figure 1 and 3.

Empirical investigations have led to the following valuation of the centre-types:

Type 1 + + + +

Type 2 — + + +

Both types nearly have the same value. They indicate central places with a relative big hinterland. Type 2 will be more advantageous, if, with the same BCD-values, A is under average. This might mean a better structure of the establishments (big firms, department stores).

Type 3 — + + —

Type 3 is on a lower level than 1 and 2. The number of firms is under average. This is not yet disadvantageous, as BC are over average. This type of centre often has reserves in the employees, which can be made active by economization or by an extension of the hinterland.

Type 4 + + + —

Typical central places outside of agglomerations. Over average values of ABC indicate central functions, the under average value of D a low utilization of the employees.

Type 5 — + — —

Type 5 is a level below type 3. As a characteristic of central importance B appears. At the community level the type indicates bigger towns in the core-area of the Ruhrgebiet with reduced hinterland.

Type 6 + + — —

A touch of central-place functions can be seen, but the utilization is even lower than in the types 4 and 5.

Type 7 — — — —

Typical for communities, which lay in the overlapping consumer areas of bigger centres. Central functions are, if any, underdeveloped.

Type 8 — — — +

This type only appears in such an extreme monostructured industrial city like Leverkusen. In the Ruhr-area, it frequently appears in statistical districts, which have a high proportion of working-places in the iron-, steel-, and mining-industries, or which residents are more than average employees of these industries. This can be explained with the high rate of foodsales.

Type 9 + — — —

This type is even more disadvantageous for bigger communities than type 8, as the value for the establishments is over average, but no other values over average are produced. It indicates settlements with low density with many, not utilized shops, polycentral communities and an obsolete intern structure of the firms.

This ratio-method was used for the following levels of investigations:

1. statistical districts on a regional level
2. communities on a regional level
3. communities on a country level
4. communities on a state level.

The examples cited here have been taken out of the last two parts of the investigation. A special interest we took in the following relations:

1. Relations between town-size, population density and retail efficiency
2. Relations between town location, retail centrality and retail efficiency.

Relations between town size, population density, and retail efficiency.

One of the reasons for the different efficiency, we found, is the population density. If we use this statistical term, it should be recapitulated what it means: There can be a compact build or a wide spread town in a large community area. Both would have the same population density. But the difference for a rational use of the services will be clear.

Out of all towns with more than 100 000 inhabitants in the GFR (fig. 1 and 2), only 15 have a sales per employee ratio over 43.000 DM. But out of these 15 towns, 9 have a population density of over 3.000 inhabitants per sq. km. The 6 towns with a lower density are known for a dense town-structure.

In the investigation in Nordrhein-Westfalen, we found the same relation between population density and efficiency. The following table shows the towns in Nordrhein-Westfalen with an efficiency over average:

Town	inhabitants in 1000 1961	inhabitants per sq. km 1961	sales per employee in 1000 DM 1960
Lüdenscheid	4.600	58	46,6
Bonn	4.596	144	44,3
Düsseldorf	4.439	702	45,5
Essen	3.857	726	43,4
Bielefeld	3.728	175	43,6

The location of these towns will be shown in figure 3.

They are those with the highest population density in Nordrhein-Westfalen, with the exception of Wanne-Eickel, which has two main centres. We found, that polycentral towns generally have a lower efficiency than monocentral ones.

As the table above shows, there is no relation between town-size and efficiency.

But for a rational retail structure, the influence of the town-size is important. Rationalization is expressed in a low or under average shop-ratio in connection with a high or over average employee- and sales per inhabitant ratio.

In the Ruhr-area, a distinct rationalization starts at about 90.000 inhabitants of a town, in the GFR at about 130.000 inhabitants. But these marks do not mean at the same time an over average efficiency.

As the average of the GFR is very low, the cities in fig. 1 still seem to be relatively efficient. Inquiries in the retail-trade showed, that a rationalized retail structure in all branches in 1960 had an average sales per employee of about 50.000 DM ¹⁾. If this value would be taken as a measurement, only the cities Saarbrücken, Stuttgart and Frankfurt would reach this level. With a measurement level of 43.000 DM, which has been applied in the Ruhr-area investigation, 12 more cities reach it. But instead of 37, still only 15 cities meet higher demands of efficiency. They are, with the exception of the cities in brackets, regional metropolises. These metropolises are, seen from North to South: Hamburg, Hannover, Bielefeld, Essen, Düsseldorf, (Bonn), (Wiesbaden), Frankfurt, Mannheim, Saarbrücken, Nürnberg, Stuttgart, München, Freiburg. So, we can conclude, that a rational structure of shops and a high efficiency only happen on the level of regional metropolises.

Relations between retail efficiency, retail centrality, and location of a town.

Figure 1 shows all towns with over 100.000 inhabitants in the GFR. The total number is 52. There are 9 towns of type 1 and 28 of type 2. These together are 37 or 71 %, with over average sales per employee.

The locational pattern of the different types shows, that there is a distinct relation between retail efficiency and town-location. Most of the towns with under average sales per employee are located in zones with predominant influence of other towns or in corners of the country, where the hinterland is geographical (coast, borders) or substantial (income) limited. In the first case, the towns Augsburg, Salzgitter, Ludwigshafen, Offenbach, Bottrop, Wanne-Eickel, Remscheid, Herne, and Oberhausen, in the second case the towns Osnabrück, Lübeck, Bremerhaven, Wilhelmshaven, Oldenburg, and Braunschweig have to be mentioned.

Figure 3 does even more show these regularities: In the centre of the map the Ruhr-area is to be recognized by the many different types of towns. There are towns with the lowest level (type 7), but also such with the highest one (type 1, 2). A place

¹⁾ Betriebsvergleich des Instituts für Handelsforschung, Köln, 1961.

of a high level always is surrounded by some places of lower level. Type 7, 6 and 5 represent communities with purchasing power efflux, type 1, 2, 3 and 4 such with influx.

The core of the Ruhr-area thus is a chain of centres with influx of purchasing power. The chain is formed, seen from West to East, by Duisburg, Mülheim, Essen, Gelsenkirchen, Bochum, and Dortmund. In the North of the area, Recklinghausen and Gladbeck have developed at an advantageous location, in the South Witten. The next places with central functions, on a smaller scale of course, can only be found in some distance at the edge of the agglomeration. These are the places marked type 4 or 5. Typical it seems to be, that at the outside of the agglomeration no places with over average efficiency have developed. It may be stated, that the highest efficiency is found in the central point of the agglomeration, in Essen. Düsseldorf as well, as a place with an advantageous location between Rhein- and Ruhraxis, reaches a very high value. But Dortmund, Duisburg, and Köln, cities with remarkable hinterland, known as trade centres, do not reach that high value.

Therefore it can be concluded, that a high efficiency is, as explained above, on the one hand due to a high population density, and on the other hand to the central location of the community. The more central its location is, in rural areas or in agglomerations, the higher is the demand out of all directions. This results in an advantage over other communities, which, with hinterland cut down in the one or the other direction, only reach lower values.

The higher the ratio of employees and the sales per inhabitant are, the higher, in general, is the centrality of a community. The relations between retail centrality and efficiency are shown in fig. 2 and 4. The lower the rate of employees and the higher the sales per inhabitant are, the higher is, too, the efficiency. A good example for these relations are the lines of the cities Stuttgart and Frankfurt (fig. 2). Stuttgart only has 45 retail employees per 1.000 inhabitants and 2.150 DM retail sales per inhabitant, but it reaches a higher efficiency than Frankfurt with 55 retail employees and 2.580 DM sales per inhabitant.

In some cases a relation between centrality and efficiency can be found (Saarbrücken, Frankfurt, Stuttgart), but it is not conclusive, as Stuttgart proves. The number of retail employees is not only a characteristic of centrality, but also one of structure; the same is true for the number of shops. Therefore, Bochum, with only 39 retail employees per 1.000 inhabitants, again reaches sales per employee of 43.000 DM, while Kassel with 55 employees only comes to 40.000 DM.

A high ratio of employees indicates a high offer of service, and, by that, high centrality. If this high offer of service, however, is not demanded intensively enough, a low efficiency results. This indicates a too small hinterland, jerking demand, and a disadvantageous settlement-structure of the community. Cities like Stuttgart and Bochum, which have nearly no sub-centres and are strongly concentrated to one core, get an accordingly high efficiency. A direct relation between the efficiency of

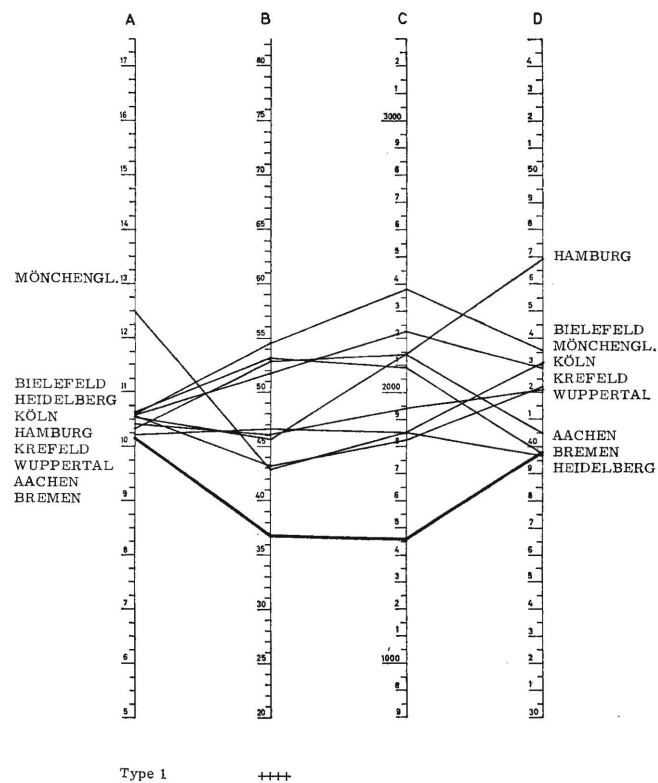
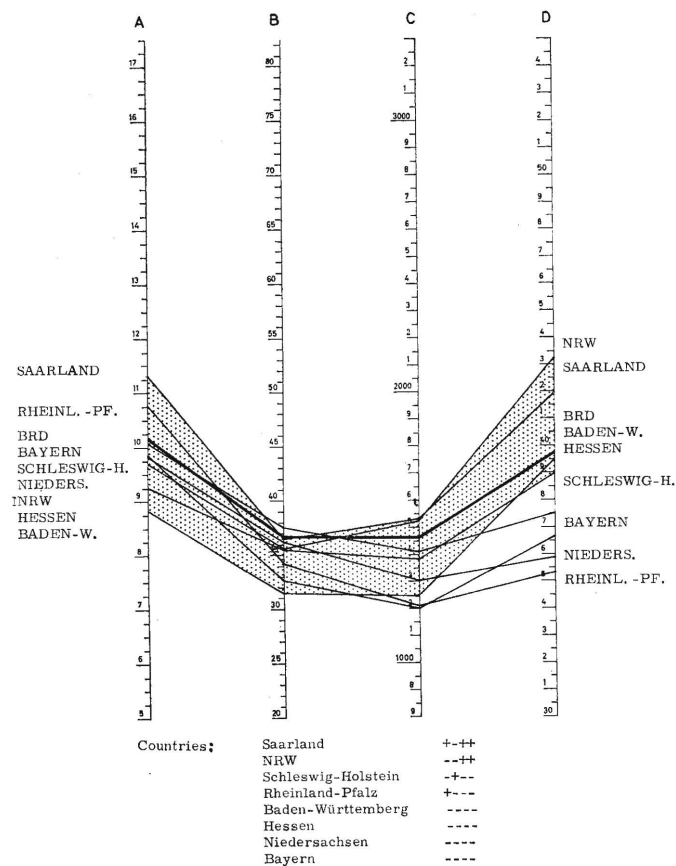


Fig. 2. Legenda, see p. 433

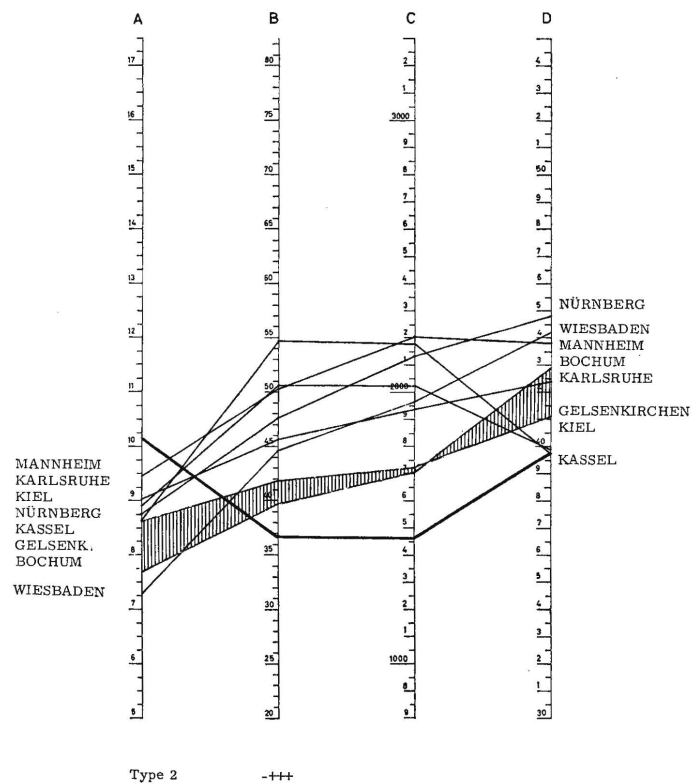
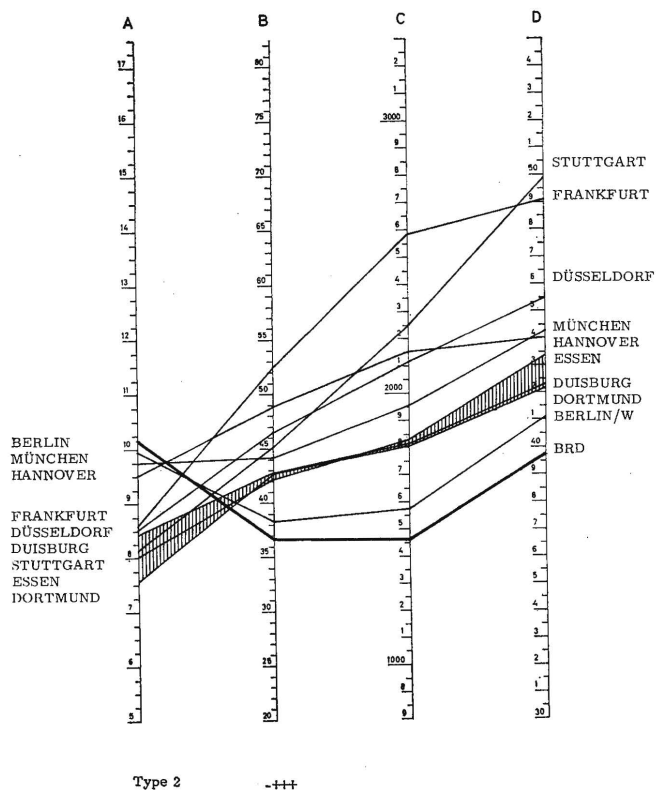
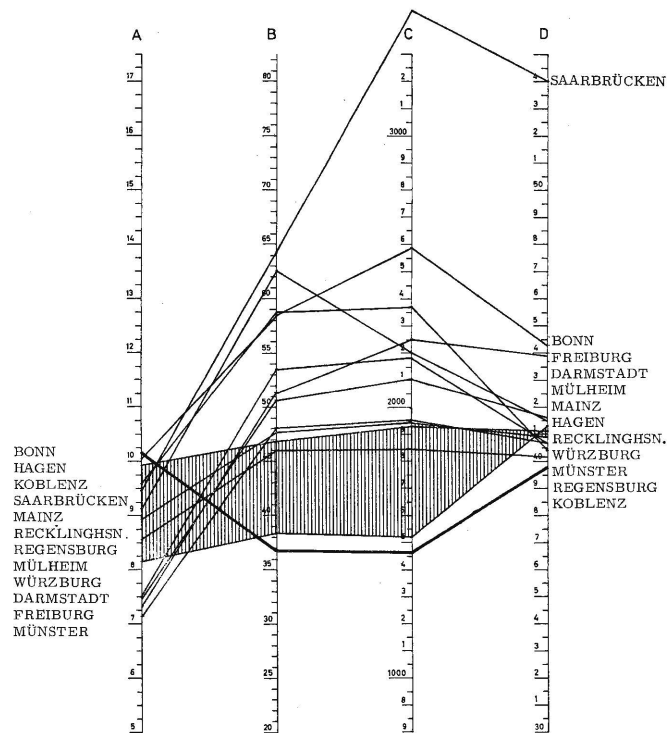
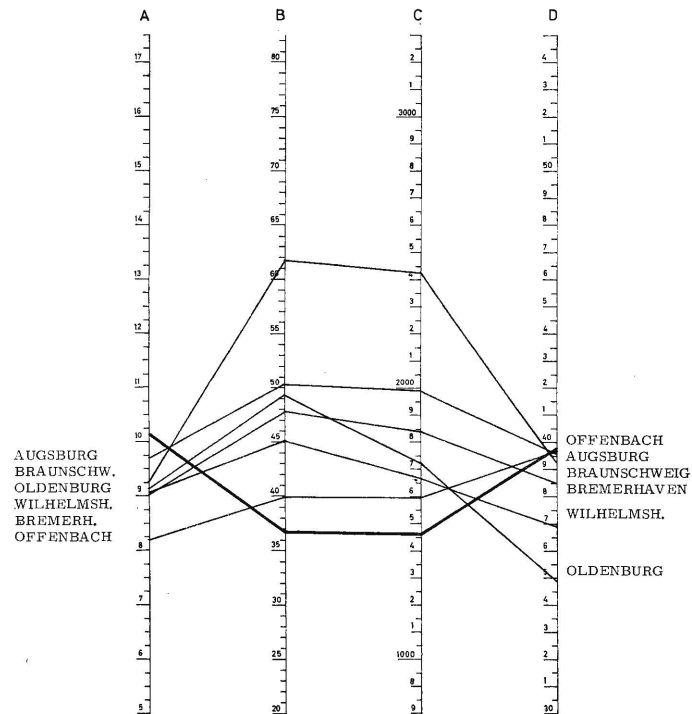


Fig. 2 (Continued).



Type 2

---+



Type 3

---+

Fig. 2 (Continued).

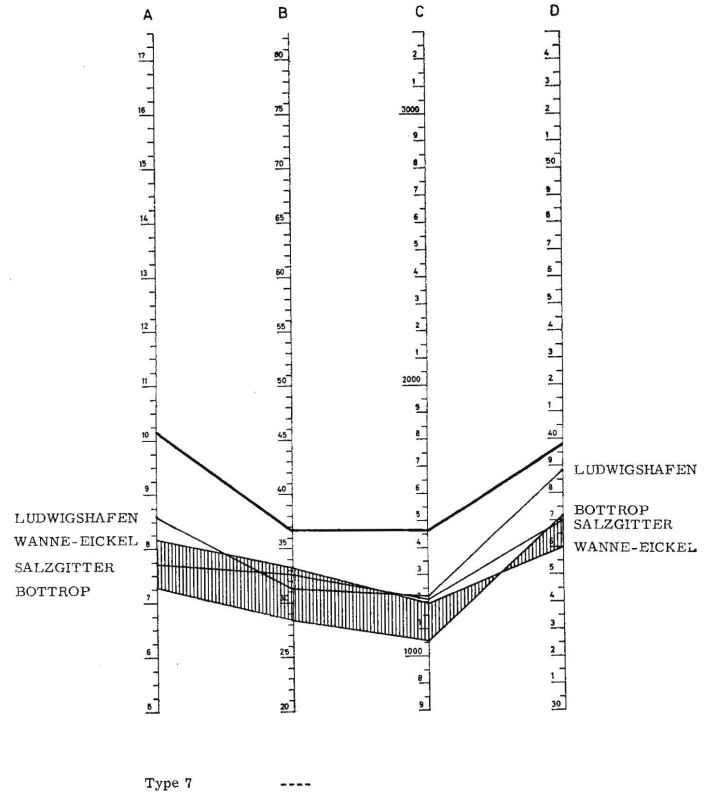
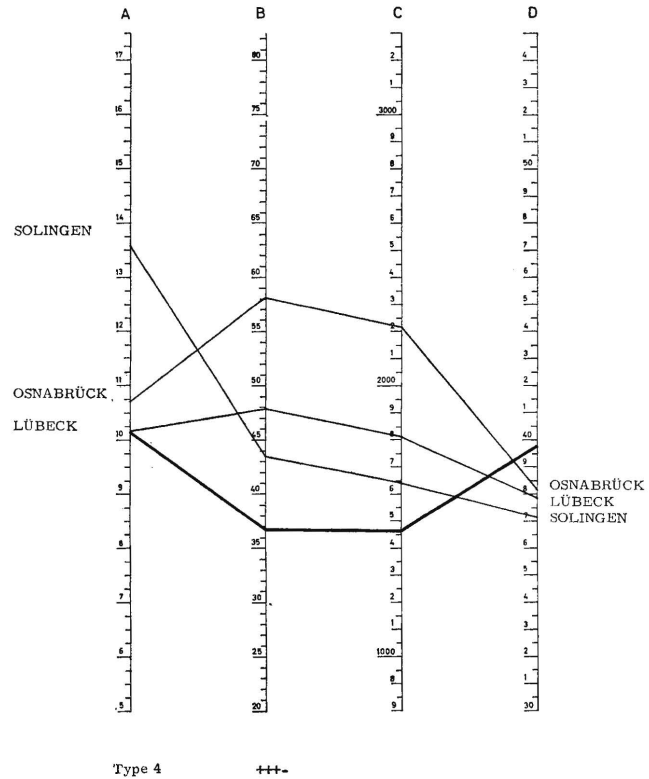
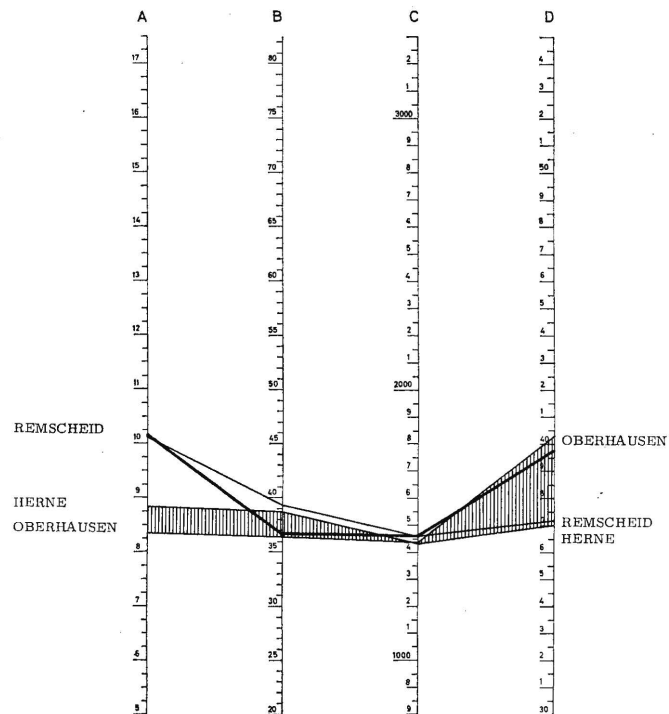


Fig. 2 (Continued).

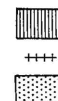


SOURCE: CENSUS OF COMMERCE 1960

+ = OVER AVERAGE OF THE STATE
- = UNDER AVERAGE OF THE STATE

A = SHOPS PER 1000 INHABITANTS
B = RETAIL-EMPLOYEES PER 1000 INHABITANTS
C = RETAIL-SALES PER INHABITANT IN DM
D = SALES PER RETAIL-EMPLOYEE IN 1000 DM

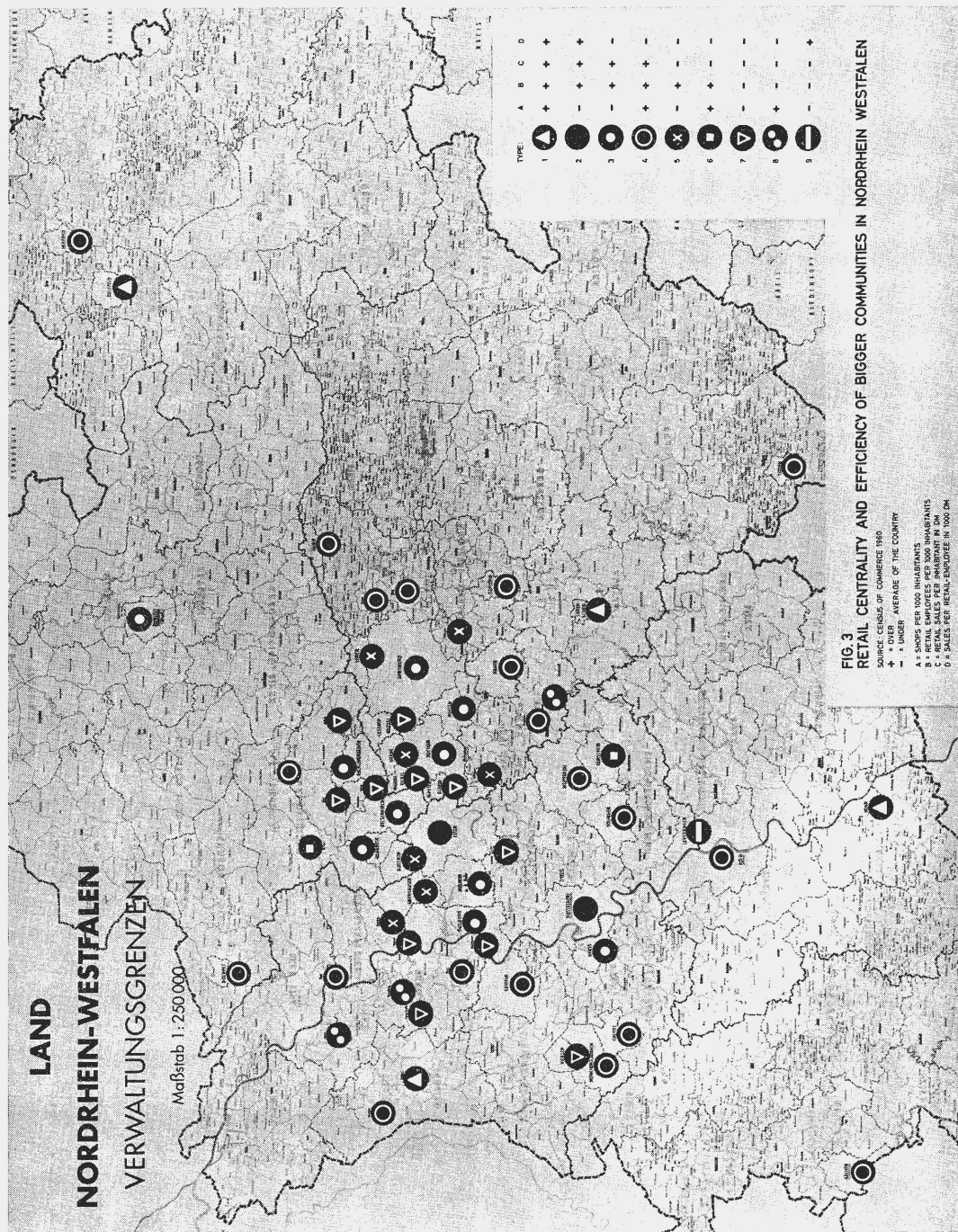
RUHR AREA
TYPE OF COMMUNITY
INDUSTRIALIZED COUNTRIES



Type 5 --- Herne
Type 6 +++ Remscheid
Type 9 ---+ Oberhausen

FIG. 2

RETAIL CENTRALITY AND EFFICIENCY OF TOWNS WITH MORE THAN 100.000 INHABITANTS IN THE GERMAN FEDERAL REPUBLIC



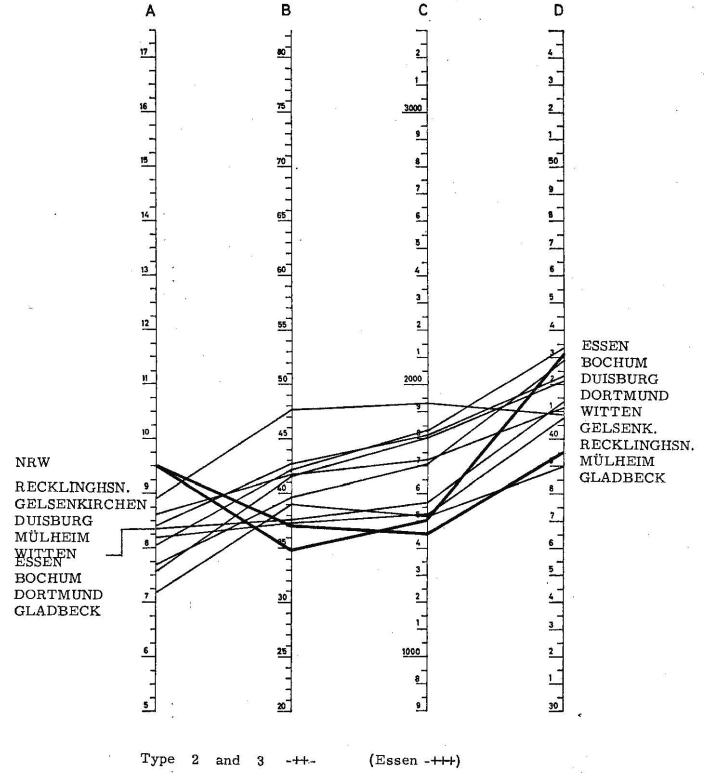
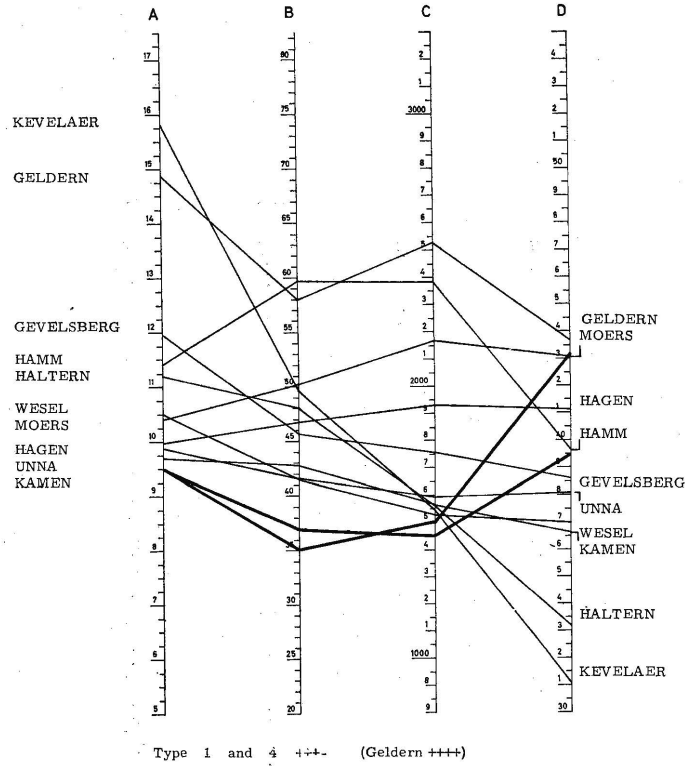


Fig. 4 legenda, see p. 437

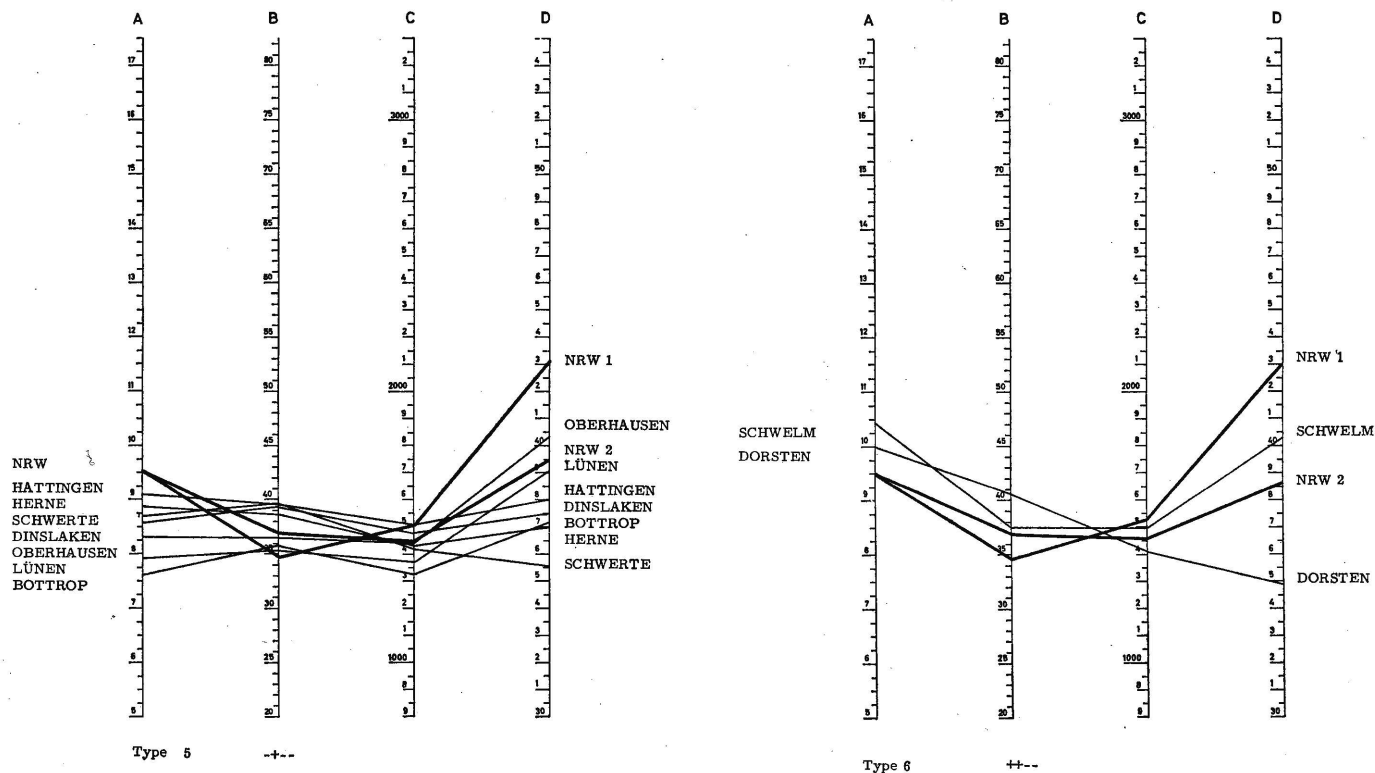


Fig. 4 (Continued).

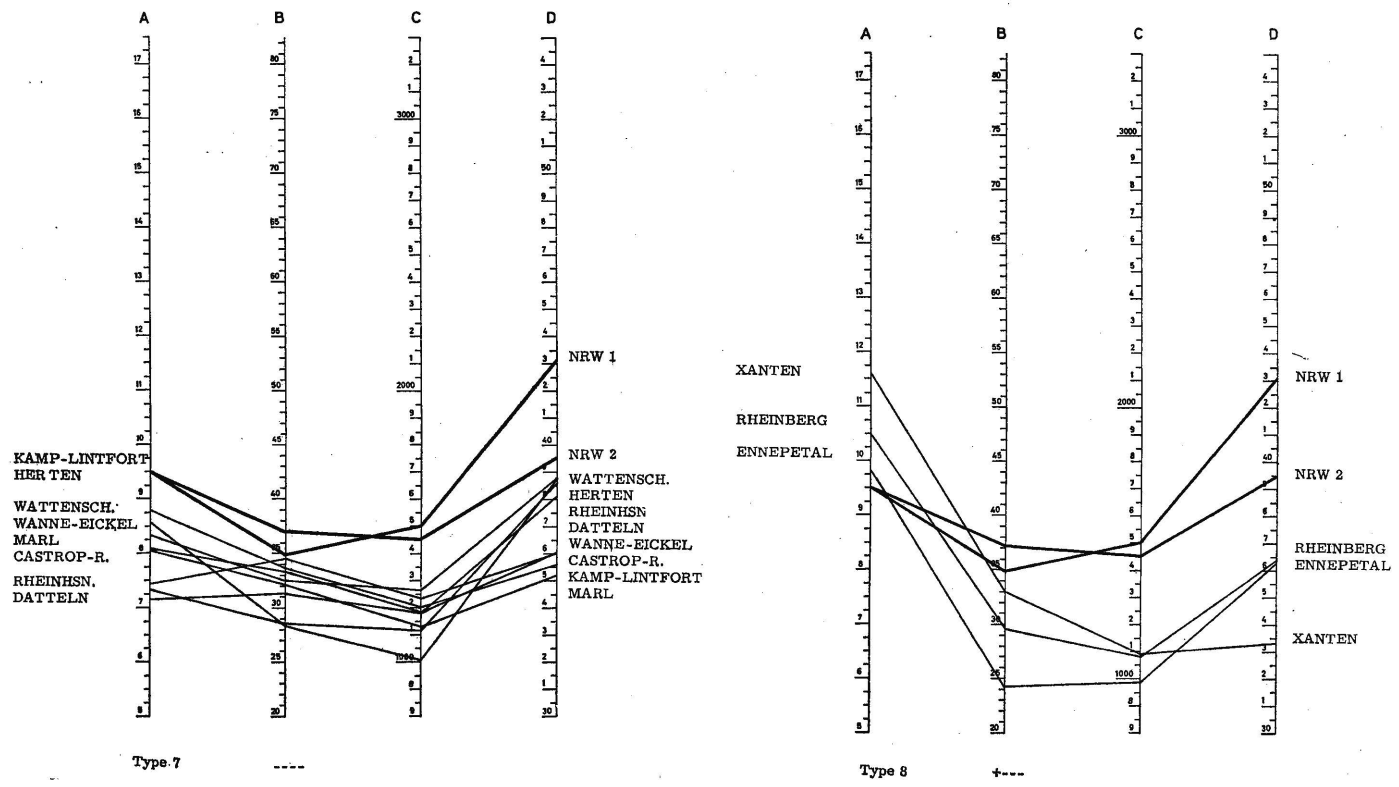


FIG. 4

RETAIL CENTRALITY AND EFFICIENCY OF BIGGER COMMUNITIES IN NORDRHEIN WESTFALEN

SOURCE : CENSUS OF COMMERCE 1960

+ = OVER AVERAGE OF THE COUNTRY
 - = UNDER AVERAGE OF THE COUNTRY

A = SHOPS PER 1000 INHABITANTS
 B = RETAIL-EMPLOYEES PER 1000 INHABITANTS
 C = RETAIL-SALES PER INHABITANT IN DM
 D = SALES PER RETAIL-EMPLOYEE IN 1000 DM

the community and the number of sub-centres has been found: All cities in the Ruhr-area, which have one or more strong sub-centres, have a lower efficiency than cities, which are mainly concentrated to the core. Polycentral cities without a dominant core show, in spite of high population density, the lowest levels.

With the informations about the structure of the trade in the neighbour-communities, which could be gained relatively quick with this ratio-method, statements about the possible development of the cities in the Ruhr-area could be made much more certain. Important was the information, which communities in the edging zones will be, according to their advantages in location and the dynamic of the structure of their retail trade, especially increasing, and which cities in the core of the area will loose therefore a remarkable part of their hinterland. Starting out with this information about the region, detailed analysis' of the cities have been made, and the amount of retail sales, which is to be required, has been calculated for each city in the Ruhr-area.

For the communities as a whole, similar calculations have been made. The maximum size of a sub-centre then has been empirically defined with 20% of the city sales as a variable, depending on those. Taking in account the required sales of the core, the expected total sales, and the maximum size of one sub-centre, the maximum number of subcentres for each community could be derived with the following equation:

$$n = \frac{(U_g - U_{c_0}) \cdot k}{U_{c_0} \cdot a}$$

n = number of sub-centres

U_g = expected retail sales for the community

U_{c_0} = expected retail sales for the city

k = amount of the difference $U_g - U_{c_0}$, which can be concentrated in sub-centres (40-60 %)

a = maximum sales for one sub-centre (20-25 % of the city sales).

SUMMARY

In order to get a general view of the degree of development of neighboured or competing communities during the analysis of an urban core, a town, or parts of a region, a ratio-method has been developed, which allows a valuation of the relative centrality and the efficiency for the retail sector. It has been found, that this method gives a sufficient picture of the competition in a centre-system without great effort. In the here mentioned investigation in the Ruhr-area it proved, that the informations about the centre-system are especially valuable for investigations in smaller areas.