

JOSEF HŮRSKÝ

## ON THE PROBLEM OF TRANSPORT-GEOGRAPHICAL BOUNDARIES

Geography of industry and geography of agriculture, as well as geography of transport or social geography, justify their special criteria for defining spatial units. Considerable literature can be found on this object, but very few of these studies are concerned with methods of the definition of the concrete boundary line. From three different approaches used to define regions (geographical units), most attention is paid to the spheres of influence (nodal regions, economic declivity areas) which are in their construction far simpler than the others. Nevertheless, the balance (synthesis) of boundaries defined by various doctrines meets with difficulties in this case too.

There are mainly two problems to be mastered, namely the rank of importance of criteria on principle and the meditation among the different boundary lines just plotted. The first factor follows the general economic character of the area; and it is impossible to find a method generally applicable. But in this little contribution to the problem we want to help the synthesis of boundary lines drawn in a map on a considerable scale (e. g. 1 : 200 000) by classification of the boundary lines according to their significance (sharpness). The example demonstrated shows the method on commuting boundary lines in a part of the province of North Bohemia.

It is well known that the geographical boundaries are not in their course of the same significance (sharpness), but only exceptionally do geographers distinguish two degrees at most, i. e. besides the normal type of boundary lines a virtually rare case of transitional zone given by natural conditions (e. g. "Naturräumliche Gliederung Deutschlands, Sheet 179") or by a very low density of population as mentioned in detail below.

Some introductory words on the situation of the definition of the transport boundaries in general: Many geographers place the transport-geography standpoint among the conceptions of the boundaries of economo-geographical regions according to their importance on the second place — just behind the point of view of the geography of industry or of the geography of agriculture. The situation in the research of the economo-geographical boundaries in the world literature does not correspond to this place, especially in relation to the concrete search for boundary lines and not only to the search for theoretical considerations and principal notions. (In recent years more attention has been paid to the given problem even from the point of view of the geography of retail business.) In Czechoslovakia the delimitation of regions from the point of view of the transport geography is at its beginning — for far more attention is paid to the geography of population, to the geography of settle-

ments or to urban geography than to the transport-geography, which is therefore the "Cinderella of geographers" (Appleton 1962) in Czechoslovakia more than in other countries.

The question to be dealt with in transport-geography is similar as in other economico-geographical disciplines but the difficulties are greater because surveys of rail and road traffic cannot be done in such a detail as the census of flats or factories.

If the construction of boundary lines is based on a dynamic phenomenon, i. e. the flow of public transport, the boundary could be taken as a very special type, analogical to watersheds. The author borrowed this expression from physical geography in 1957 in a paper dealing with the development of "immigration-divides" between Prague and Vienna (Journal of the Czechoslovak Geographical Society 62). The persuasiveness of this comparison follows also from the "Explanatory Text No. 6" to the Local Accessibility Map of Great Britain (Chessington 1955, scale 1:625 000) which was one of the main inspirations for our paper. On page 4 it states that they may resemble the watersheds, "some of which are clear-cut crosslines between valleys while some are poorly defined swellings in a lowland".

One of the primary delimiting criteria is that of quantities carried, in personal transport that of numbers of passengers. The best and most exact method of recognizing the geographical structure and frequency of traffic flows from villages is of course to ask the inhabitants. Such surveys coping with certain specific problems within limited regions have occasionally been made in Czechoslovakia. A speedy and economical portrayal of province-wide conditions requires supplementary sources of information. The text to the Local Accessibility Map mentioned above notes that "the experience of bus operators has discovered the most profitable routes by a process of trial and error — a process which in effect is equivalent to an elaborate but empirical questionnaire to discover the public demand for transport to various centres".

The map — undoubtedly prepared by, or at least plotted at the suggestion of, F. H. Green the author of "Urban Hinterlands in England and Wales: an analysis of bus services" (Geogr. Journal 1950) — served us as a prototype for the construction of "frequency-divides" rather than for "commuting-divides". Even for primary purposes, however the method had to be diluted because in the greater part of Czechoslovakia it does not apply that the frequency cartodiagrams superimposed on one another make it "easy to draw boundary lines between places which had better bus facilities to one centre and those which had better facilities for reaching another centre".

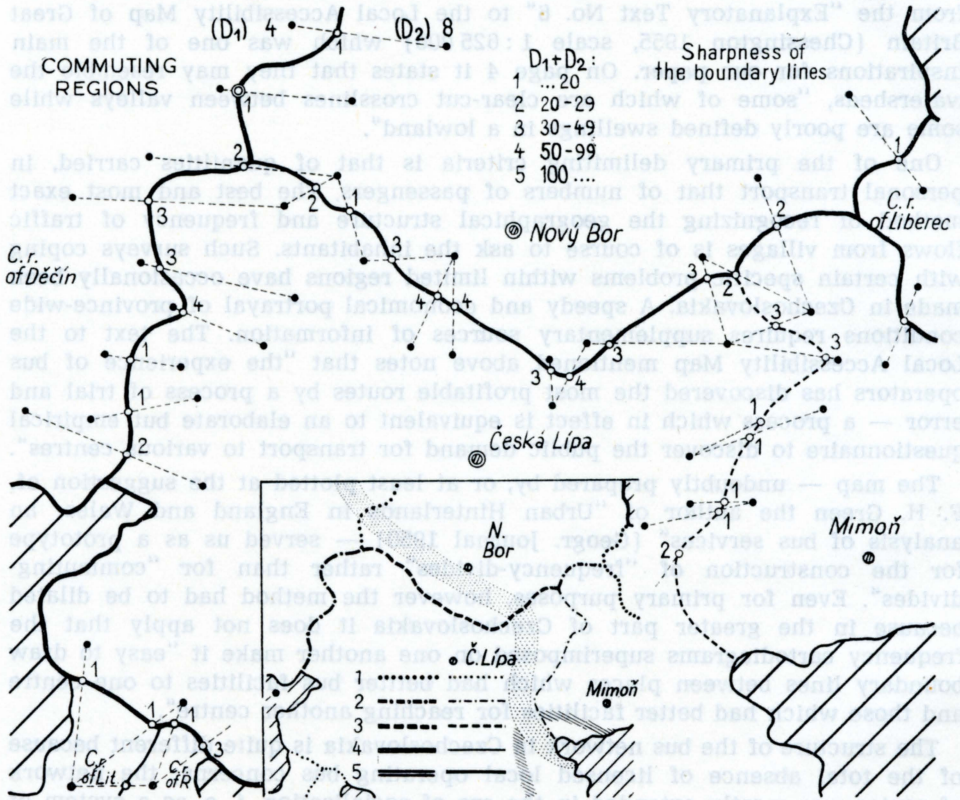
The structure of the bus network in Czechoslovakia is quite different because of the total absence of licensed local operating bus concerns; the network of routes was mostly extended in the era of socialisation, i. e. as a system of centrally planned bus services. Moreover, the network of routes in this country is less stabilized, and therefore the opinion that "most new bus services merely intensify the existing network of routes" cannot be accepted (Explan. text mentioned, p. 10).

Really inevitable, it was found, is the inclusion of passenger rail transport because in this country the bus cannot be taken "as representative of all kinds of transport". It is therefore impossible to define a centre as "a town or village having at least one regular stage carriage service operating only

to and from places smaller than the centre itself". (Explan. text of the map mentioned, p. 4).

At the time when this paper was written, two attempts to delimit the boundary lines in a more comprehensive manner were index work, the one based — in principle, as that of F. H. W. Green — on frequency, the other, of a more qualitative character, on "time accessibility". In the map mentioned, certain less relevant routes have been truncated in order to make the illustration more compact. We go further in renouncing diagrams altogether and in finding sufficient the analyses of the situation in the boundary zones supposed. The same thing holds for the third method which we describe in detail.

Our contribution concentrates on "commuting divides". There exist some differences in the preparation of statistical tables. In almost all statistics on



- Fourth and Fifth Order boundary lines classified as to their significance (sharpness) and their relation to the boundaries of the Second and Third Order. The dotted stripe delimits the fields of influence of both main northbohemian Second Order centres Ústí n. L. and Liberec, the other (hatched) those of Děčín and Mladá Boleslav. Hatched areas show neutral (transitional) zones. Abbreviations: D — Difference between the influence intensity of one of both "competitive" centres. The sum  $D_1 + D_2$  fixes the degree of sharpness of the boundary lines sections (distinguished by dotted lines, dot-and-dashed lines etc.) — Lit. — Litoměřice, R. — Roudnice.

commuting, the communities are the smallest regional units, but in Czechoslovakia it is possible to recognize even the commuting flows from settlements (in Czech "osada"). On the other hand, there are distinguished only out-commuting flows, but the in-commuting for only 335 selected towns and sub-towns (i. e. 94 % of towns and 34 % of subtowns). In this place we cannot help mentioning the classification of towns and delimitation of their spheres of influence. The opinion that "these are quite distinct processes" and that "certain places qualify for only one or other of these two classifications" is not acceptable (Explan. text mentioned p. 9). There are some towns and subtowns with complicate overlappings of their spheres of influence, but it is not possible to dispose of a town for not having a clear hinterland.

The elaboration of census 1970 will probably take into consideration not only all subtowns (about 350), but also some larger "industrial villages", e. g. with more than 200 incommuters. It will then be possible to draw even in Czechoslovakia "dynamic" maps of commuting areas. The recognition of changes in their shapes as was done by Lawton in 1963 (The Journey to Work in England and Wales: Forty Years of Change. Tijdschrift vor econ. en social. geografie 54) suggests many practical applications.

For the previous International Geographical Congress in London the author of this paper wrote a report "Commuting Intensity of Czechoslovak Towns" (Congr. Suppl. of Journal of the Czechosl. Geogr. Soc. 70) where he recognized and described the situation of towns themselves but he did not deal with their commuting fields. Closer to the theme was his article "Problem of the Remoteness of the Work Place" (Bulletin of the Czechosl. Academy of Sciences 73/1964) which was also used for constructing both commuting maps in the National Atlas (sheet 30).

There is no sound knowledge of who at first considered the utilisation of commuting data for regionalisation purposes, but among the earliest papers which dealt with the problem are Hartke's, especially the one published in 1939. ("Pendelwanderung und kulturgeographische Raumbildung im Rhein-Main-Gebiet". Peterm. Geogr. Mitteilungen 1939, p. 6). Commuting regions themselves were called by Hartke "regions of influence structure" and also neutral zones and "complex zones", i. e. regions with many overlappings (later called "interlacing zones") were already distinguished. Only approximately — because of the mostly too broad neutral zones — commuting boundaries could be delimited in the map of Macka "Regions of Commuting in the Czech Lands" (Brno 1967, scale 1 : 750 000).

The advantage of the commuting method is the detail of data concerning the phenomenon, its disadvantage is the incompleteness, as it is limited to travel between place of residence and place of work. There are data on workplaces of inhabitants from every community — where necessary, even for separate settlements — and therefore the number of fixing points is greater than in any other type of communication boundary. The standard distance for Bohemia and Moravia might be settled at 2 km.

Settlements with a strictly equal percentage of out-commuters into the two opposite centres are exceptions. Nearly all fixing points are situated between two communities (settlements) with predominance of attraction of one or the other centre. These "determinating points" are usually in areas with a dense communication network adjoining; on the other hand, where there are three more settlements intermediate, the existence either of a "neutral zone" or of

fields focusing on another centre must be recognized. If these points are a distance of more than 4 km from each other, the "fixing point" must be determined by means of vectors addition presented by the percentage of out-commuters — in one or the other centre — of all active inhabitants. (Less convenient is the percentage of total of out-commuters, as is so often applied, e. g. in the commuting maps of Planungsatlas Hessen, ed. 1960.) In greater detail and with examples is the method described in a special article published in the News of the Institute of Geography of the Czechoslovak Academy of Science, No. 9, 1966 entitled "On the Problem of the Balance of Economic — Geographical Borders". (Czech, with English summary) In order to make the outline clearer we fixed a scale of five progressively increasing degrees (— 20, 29, 49, 99 — %).

The sketch enclosed was drawn on the scale of 1:200 000 and is printed on 1:250 000. The dominant idea proposed is that there is no coming to terms with approximations admitted in the Explanatory Text of the Local Accessibility Map mentioned (p. 7). "It is not intended to imply that these boundaries represent sharp or well-defined divisions; they are in fact zones of transition from the influences of one centre to that of another, in which the influences of the two centres almost balance or are in competition... the boundary lines are drawn along the middle of the zones". In our opinion it seems to be necessary from the geographical point of view to delimitate also the transitional zone (in the notable Commuting Map of Planungsatlas Bayern ed. 1961, called "indifferent", somewhere "neutral" zone), which in the passage referred to is characterized as "varying in width according to the particular circumstances of different areas". It cannot be found satisfactory that "some idea of the width of the transitional zone may be gleaned from the character of the boundary line itself; where it is fairly regular it may be assumed that the zone is narrow, and where it is sinuous, the zone is likely to be broad".

In the outline is the index of significance (sharpness) resulting from the two intensity data by their addition of compensated attraction (as example see left above  $D_1 + D_2$ ) classified in 5 degrees, conforming to it is the boundary line distinguished — generalized from one boundary crossing to the other. The sub-town Mimoň is a typical local centre (Fifth Order centre) and is therefore stated in the hierarchy of attraction fields to the fields of subsidiary centres and may be almost completely surrounded by the major area of Česká Lípa as a type of smaller regional centre (Fourth Order centre).

A small excision of the map on the scale of 1:600 000 intended contains the boundary lines of Fourth Order centre fields classified as to sharpness by the type of line (unified in sectors between boundary crossings), a single boundary line of fields of Second Order centres (Ústí n. L., Liberec) and a very short portion — in the right lower corner — of a boundary line of fields of Third Order centres (Děčín, Mladá Boleslav).

Census 1970 results will enable us to recognize the nation-wide changes of commuting areas. This will suggest many practical applications, as in some places the boundary lines of commuting areas tend to undesirable size and sinuosity. It is to be hoped that recognition will be given even to the changes in the sharpness of the boundary lines mentioned.

By "accessibility" on the Continent (accessibilité, Erreichbarkeit) in the strict sense is to be understood "time accessibility", only in the best sense of the term is the number of facilities (frequency) considered inclusively.

The classification of boundary lines as to their sharpness is easier in the case of time accessibility than in the case of frequency boundaries — where supplementary fixing points are often needed — even if it is not so easy as that of the commuting boundaries. Generally speaking, this type of communication-geographical boundaries represents points of intersection of isochrones' systems (related to various centres as starting points) but these systems of lines need not be drawn because — as in the case of frequency cartograms — it is sufficient to analyse the situation in the boundary zones only.

The time accessibility boundaries represent very probably the most perfect instrument for the present purpose but their construction unfortunately takes the most time of the three types of divides. (The procedure is impeded among other facts by wrongly compiled time tables.) The classification of the boundary lines, however, would even in this case be achievable without significant delay in the proceeding. It would undoubtedly be a good thing to take advantage of computer work as e. g. T. Hägerstrand (Sweden) recommended in his contribution to the 4<sup>th</sup> General Meeting of the Commission on Methods of Economic Regionalization of IGU in Brno 1965. There is abundant evidence that it would not be only of theoretical interest to recognize and examine the correspondence between the three types of communication-geographical boundaries described even in the qualitative respect, i. e. as to their significance (sharpness).

In conclusion, the main idea of the study should be mentioned: The suggested differentiation of economic-geographical boundary lines as to their significance (sharpness) would substantially facilitate the synthesis, i. e. the determination of the collective economic-geographical boundaries, as it would be evident at first sight to which degree the partial discipline admits a compromising solution.

#### References

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#### Résumé

##### K PROBLÉMU DOPRAVNĚ GEOGRAFICKÝCH HRANIC

Při vymezení zeměpisných celků (rajónování, regionalizaci) se aspektům dopravním nevěnuje dosud dostatečná pozornost, ačkoliv z hlediska ekonomické logiky by v tom ohledu měla dopravní geografie následovat bezprostředně za geografii průmyslu. Příspěvek — jehož účelem je hlavně seznámit širší okruh hospodářských geografů s autorovým návrhem, aby se hospodářskogeografické hranice diferencovaly podle výraznosti (ostrosti) jednotlivých úseků — se zmiňuje především o možnostech, které by poskytly statistické údaje o směrech a četnosti cest obyvatelstva jednotlivých *sídelních jednotek*. Takový pramenný materiál lze ovšem získat jen zvláštním šetřením, podniknutým např. v rámci přípravy podrobného hospodářskogeografického výzkumu malé oblasti. Sčítání lidu skýtá jen údaje o pravidelném *pohybu obyvatelstva za prací*.



I když tyto číselné podklady nezahrnují pohyb za vzděláním (školní dojížďku ap.) a většinu cest do středisek služeb (včetně nákupních, zdravotnických, zábavních ap.), jsou pro rozhraničování zeměpisných celků velmi cenné.

Pokud se týče dosavadního vývoje otázky, je třeba odkázat na stručnou charakteristiku úvodních odstavců autorova článku z r. 1966. V následujícím roce vydal Geografický ústav ČSAV mnohobarevnou mapu spádových oblastí dojížďky Českých zemí od M. a c k y. Tato záslužná práce je nepochybně důležitým krokem vpřed, avšak jen u malé části — patrně u méně nežli u  $1/10$  celkové délky zmíněného typu rozmezí — je možno hranice mezi sférami („dojížďkovými rajóny“) lineárně určovat. U zbývajících částí to možné není, protože se mezi ně vklíní pásma území s nerozlišenými obcemi. Tyto okrsky jsou různé šíře, takže jen na některých místech by bylo možno hranici proložit podle zásad geografické generalizace.

Jak plyne z příloženého kartografického náčrtu, navrhuje autor určovat spád zásadně u *všech* obcí a do neutrálních pásem („indiferentních zón“) zahrnovat jen obce, z nichž do sledovaných center dojíždí určitý *minimální počet pracovníků*, např. méně než 10. I uvnitř neutrálních pásem by se však určovaly další upínací body v případě, že by se na některých úsecích — především při konstrukci souborné hospodářskogeografické hranice — ukázala toho potřeba. Jinak se však „neutralité“ těchto pásem rozumí právě v tom smyslu, že se v nich ponechává volnost pro vedení hraničních čar určených z ostatních hospodářskogeografických hledisek (zemědělství, služby ap.).

V zásadě je navržený způsob hraničních čar, klasifikovaných podle ostroty jednotlivých úseků, dobře použitelný také při určování a znázorňování předělů *frekvence* veřejné dopravy i předělů *dosazitelnosti*. „Dosažitelnosti“ se tu rozumí v evropském kontinentálním smyslu slova, tj. jako dosažitelnosti „časové“, na rozdíl od britského pojetí jako dosažitelnosti „místní“, jež je prakticky totožná s frekvencí spojů. Předěly časové dosažitelnosti jsou metodicky samostatným problémem, a proto si článek všimá stručně jen obou typů předělů frekvenčních jako náhrady za zmíněný optimální ukazatel podle diferencovaných proudů.

V dalších odstavcích považoval autor za účelné zabývat se podrobněji metodou oblastního rozlišení, uplatněnou na několikobarevné „*Mapě místní dosažitelnosti ve Velké Británii*“ vydané v měřítku 1:625 000 na dvou listech neobyčkle velkého formátu. Ani mapa, ani samostatně vydaný metodický komentář („vysvětlivkový text“) neuvádí autora, avšak navrhovatelem nebo aspoň spoluautorem byl nepochybně F. H. W. Green. Na této mapě je imponující, že snad jako první provedla podrobnou prostorovou diferenciaci z hlediska veřejné dopravy jednotnou metodou pro poměrně *velké území*, což bylo hlavním podnětem k úvaze o aplikovatelnosti použitého způsobu v Československu. První podmínkou by muselo být rozšíření na dopravu *železniční* (mapa se omezuje na síť autobusovou), jejíž vliv na utváření nodálních oblastí je u nás mocnější nežli v Anglii, i když ani tam by neměl být považován za zanedbatelný. Závažnost tohoto nedostatku roste s velikostí nodální oblasti, neboť se vzdáleností přibývá pravděpodobnost, že cestující kombinuje autobus s dráhou nebo že se cestuje železniční výlučně. Proto se tato připomínka týká hlavně kartografické ukázky ve zmíněném komentáři, kde kromě hranic nodálních oblastí center čtvrtého stupně jsou zakresleny i předěly oblastí *center třetího a druhého stupně*. Zde však místo lineárních hranic nastupují hraniční pásy, a to u nodálních oblastí center druhého řádu o šířce zhruba 6 km a u třetího řádu zhruba 2 km. Touto generalizací se přirozeně usnadní řešit mnohá místa nejasného rozmezí, avšak cennější by bylo, kdyby tyto pásy měly proměnlivou šířku podle stupně ostroty hranice, čímž by se přiblížily ke způsobu rozlišování, jež navrhujeme. Konečně je třeba ještě uvést, že v Anglii je vymezení nodálních oblastí podle autobusové sítě usnadněno existencí mnoha místních koncesionářů, v jejichž traťových systémech se zvláště zřetelně odráží ekonomický spád do příslušných center.

Kartografický náčrt se sice týká dojížďky do práce, avšak znázorňování osobní frekvence by mohlo být velmi obdobné (počtu vyjíždějících by odpovídal počet příležitostí), jen by tu přibyla ještě jako *upínací body prvního řádu* místa s nejmenším počtem cestujících na tratích spjucích obě centra. Obdobně jako ukázka ve zmíněném komentujícím textu k britské mapě rozlišuje jako příklad i oblast jednoho tř. „vedlejšího“ (subsidiárního) centra a připojená zmenšenina (zhruba v měř. 1:600 000) navíc ještě zmíněné hraniční pruhy oblastí dvou vyšších řádů.