MARCHETTI-056_
Pt.3

Figure 15.

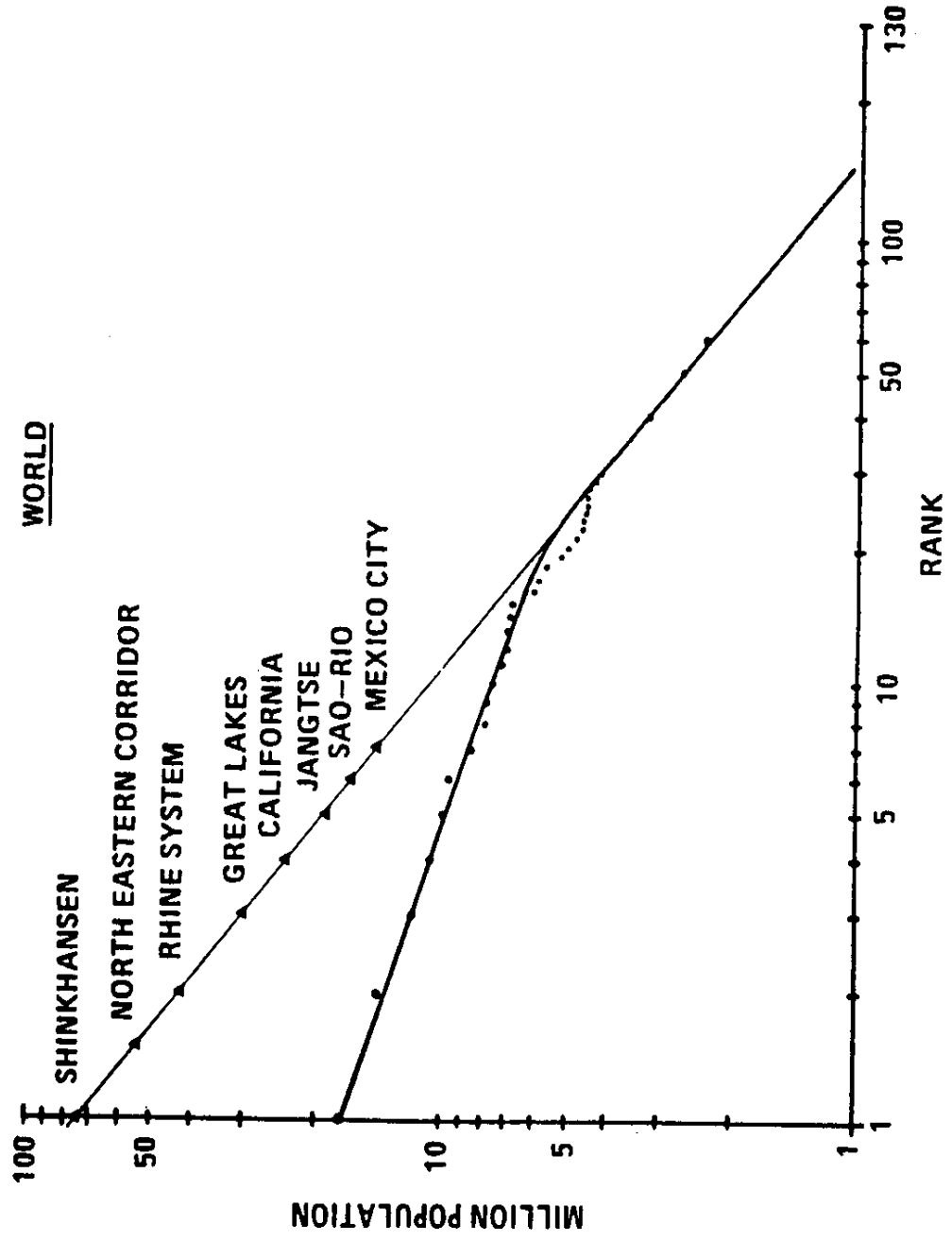

Figure 16a,b,c,d,e,f.
World urbanization trends.

In the evolution of the structure of human settlements in the world, the general tendency has been to concentrate populations into larger and larger cities, with the exclusion of Europe where the population in centers larger than one million inhabitants has been more or less stable during the last 30 years. This may lead to a weakening of the world hierarchical positioning of Europe, *unless* a number of these centers are sufficiently interconnected, in the short-time mode ($\sim$ 20 minutes) so as to integrate them completely, or in the medium-time mode ($\sim$ one hour) in order to integrate them at the highest functional level.

To give an idea of the historical trend in the localization of the world's largest cities, a set of four snapshots is reported, showing the situation in 1700, 1800, 1900, and 1985.

Figure 16a.

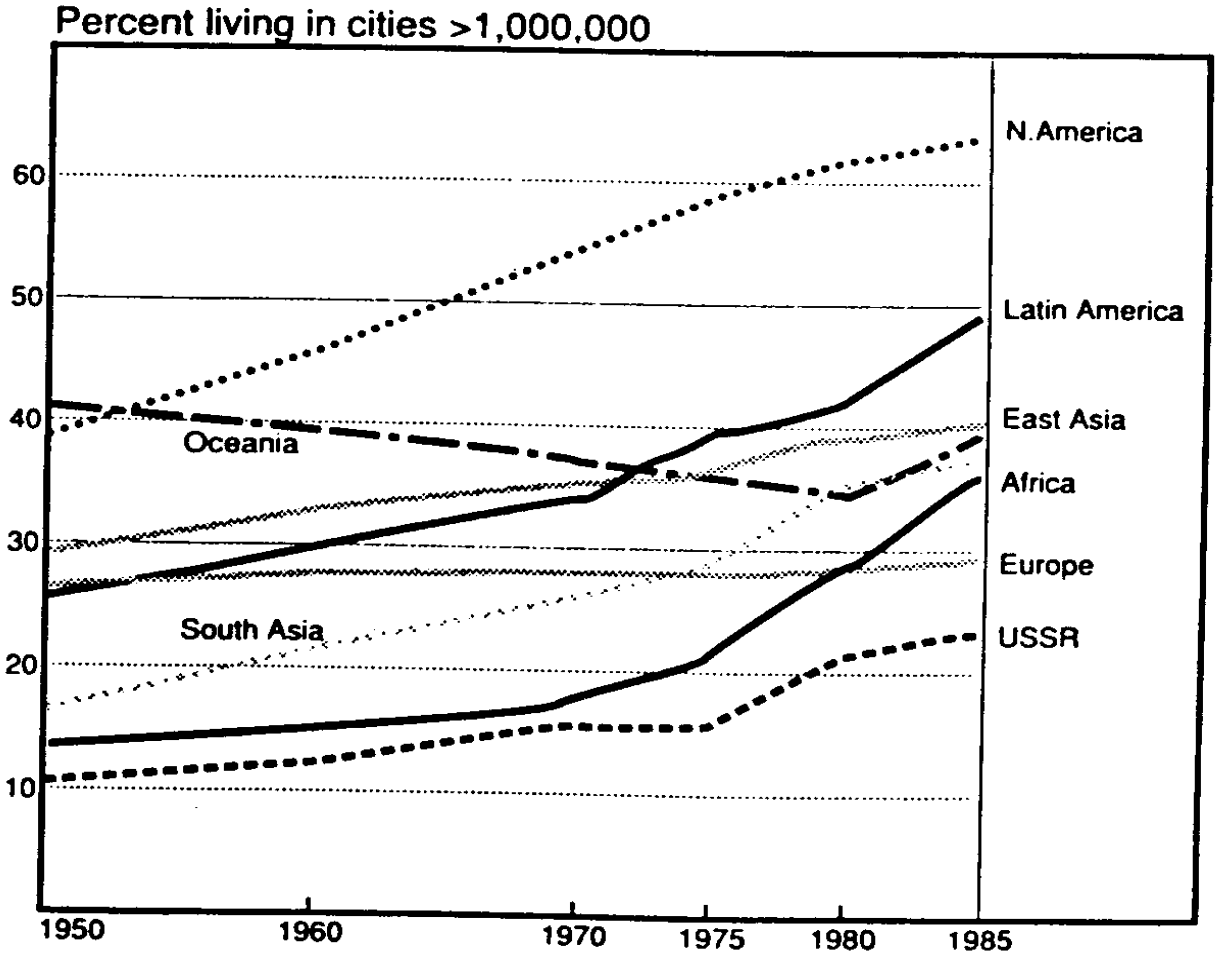
Percent living in cities >1,000,000
60
50
40
30
20
10
1950
1960
1970
1975
1980
1985
N.America
Latin America
East Asia
Africa
Europe
USSR
Oceania
South Asia

Figure 16a,b,c,d,e,f.
World urbanization trends.

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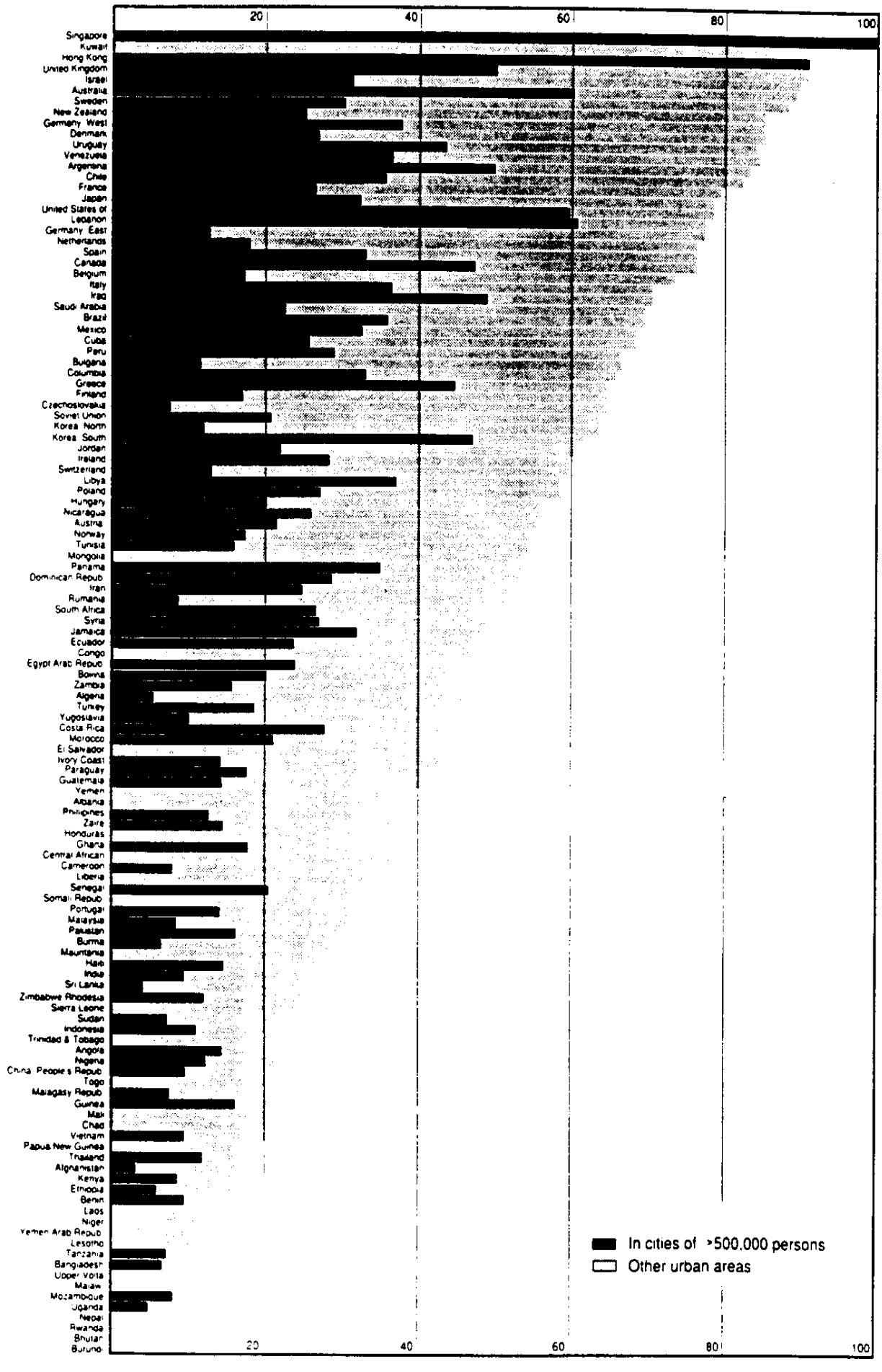
20
40
60
80
100
Singapore
Kuwait
Hong Kong
United Kingdom
Israel
Australia
Sweden
New Zealand
Germany West
Denmark
Uruguay
Venezuela
Argentina
Chile
France
Japan
United States of
Lebanon
Germany East
Netherlands
Spain
Canada
Belgium
Italy
Iraq
Saudi Arabia
Brazil
Mexico
Cuba
Peru
Bulgaria
Columbia
Greece
Finland
Czechoslovakia
Soviet Union
Korea North
Korea South
Jordan
Ireland
Switzerland
Libya
Poland
Hungary
Nicaragua
Austria
Norway
Tunisia
Mongolia
Panama
Dominican Repub
Iran
Rumania
South Africa
Syria
Jamaica
Ecuador
Congo
Egypt Arab Repub
Bolivia
Zambia
Algeria
Turkey
Yugoslavia
Costa Rica
Morocco
El Salvador
Ivory Coast
Paraguay
Guatemala
Yemen
Albania
Philipines
Zaire
Honduras
Ghana
Central African
Cameroon
Liberia
Senegal
Somali Repub
Portugal
Malaysia
Pakistan
Burma
Mauritania
Haiti
India
Sri Lanka
Zimbabwe Rhodesia
Sierra Leone
Sudan
Indonesia
Trinidad & Tobago
Angola
Nigeria
China People's Repub
Togo
Malagasy Repub
Guinea
Mali
Chad
Vietnam
Papua New Guinea
Thailand
Afghanistan
Kenya
Ethiopia
Benin
Laos
Niger
Yemen Arab Repub
Lesotho
Tanzania
Bangladesh
Upper Volta
Malawi
Mozambique
Uganda
Nepal
Rwanda
Bhutan
Burundi
In cities of >500,000 persons
Other urban areas

Figure 16b.

Figure 16a,b,c,d,e,f.
World urbanization trends.

In the evolution of the structure of human settlements in the world, the general tendency has been to concentrate populations into larger and larger cities, with the exclusion of Europe where the population in centers larger than one million inhabitants has been more or less stable during the last 30 years. This may lead to a weakening of the world hierarchical positioning of Europe, *unless* a number of these centers are sufficiently interconnected, in the short-time mode ($\sim$ 20 minutes) so as to integrate them completely, or in the medium-time mode ($\sim$ one hour) in order to integrate them at the highest functional level.

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Figure 16c.

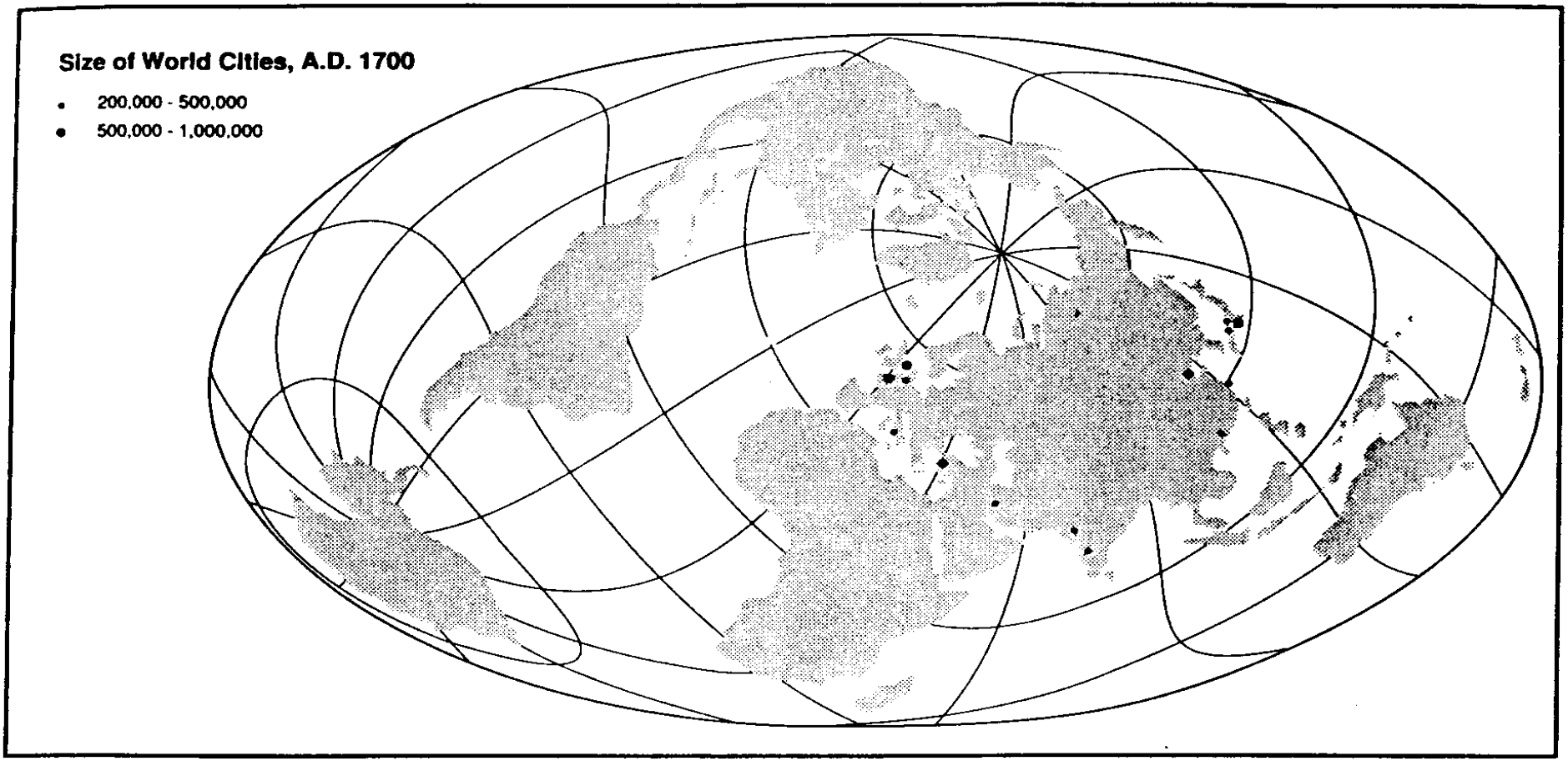

Figure 16a,b,c,d,e,f.
World urbanization trends.

In the evolution of the structure of human settlements in the world, the general tendency has been to concentrate populations into larger and larger cities, with the exclusion of Europe where the population in centers larger than one million inhabitants has been more or less stable during the last 30 years. This may lead to a weakening of the world hierarchical positioning of Europe, *unless* a number of these centers are sufficiently interconnected, in the short-time mode ($\sim$ 20 minutes) so as to integrate them completely, or in the medium-time mode ($\sim$ one hour) in order to integrate them at the highest functional level.

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Figure 16d.

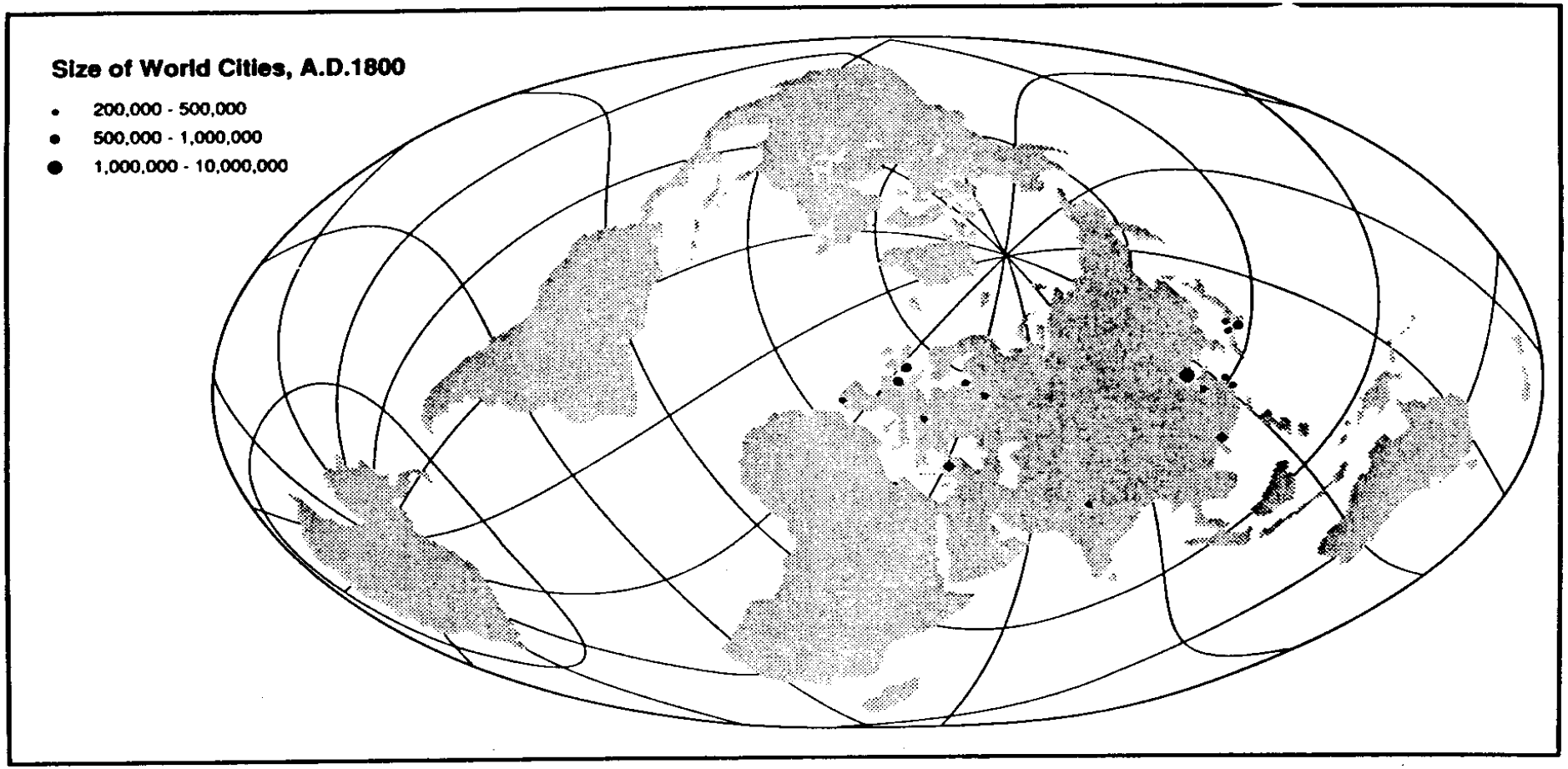
Size of World Cities, A.D.1800
200,000 - 500,000
500,000 - 1,000,000
1,000,000 - 10,000,000

Figure 16a,b,c,d,e,f.
World urbanization trends.

In the evolution of the structure of human settlements in the world, the general tendency has been to concentrate populations into larger and larger cities, with the exclusion of Europe where the population in centers larger than one million inhabitants has been more or less stable during the last 30 years. This may lead to a weakening of the world hierarchical positioning of Europe, *unless* a number of these centers are sufficiently interconnected, in the short-time mode ($\sim$ 20 minutes) so as to integrate them completely, or in the medium-time mode ($\sim$ one hour) in order to integrate them at the highest functional level.

To give an idea of the historical trend in the localization of the world's largest cities, a set of four snapshots is reported, showing the situation in 1700, 1800, 1900, and 1985.

Figure 16e.

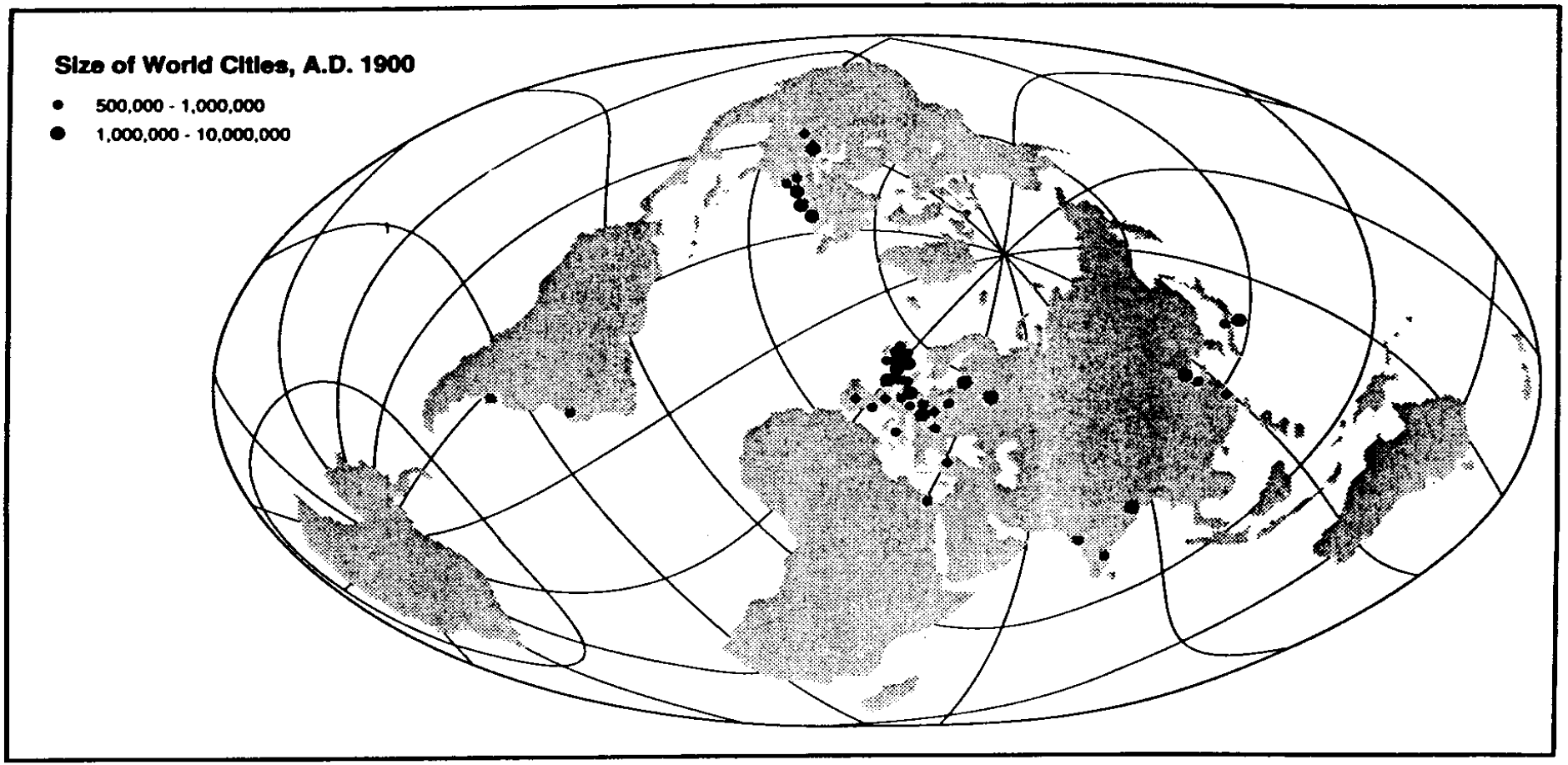
Size of World Cities, A.D. 1900
500,000 - 1,000,000
1,000,000 - 10,000,000

Figure 16a,b,c,d,e,f.
World urbanization trends.

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Figure 16f.

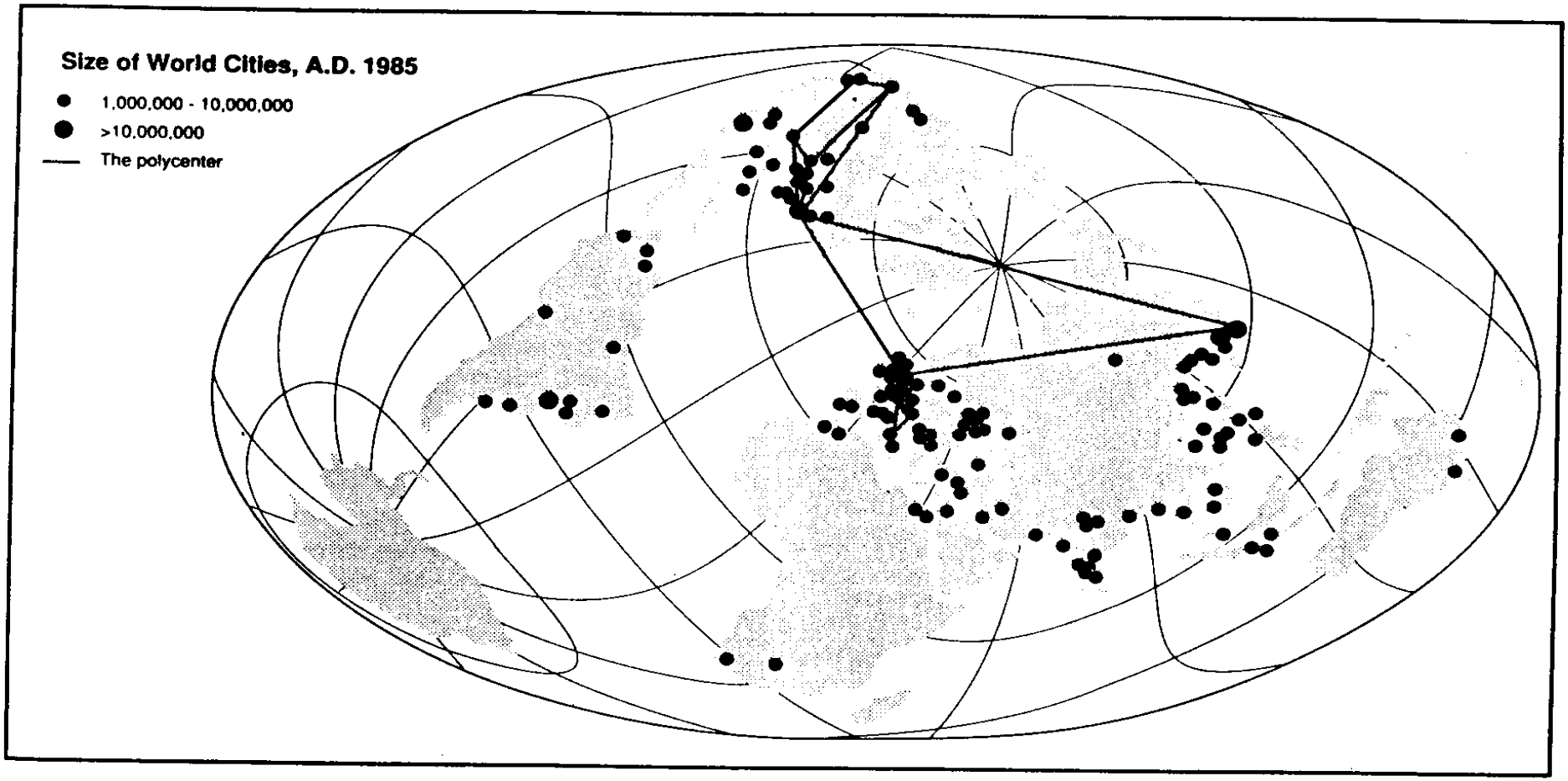

Size of World Cities, A.D. 1985
1,000,000 - 10,000,000
>10,000,000
The polycenter

Figure 17.
Intense connections in Europe.

To see how intensely two centers interact, one can resort to various indicators, telephone calls, and mail, i.e., communications, or travel, i.e., transportation. As long-range business travels almost exclusively by air, a measurement of the air connection intensity can throw some light on how things move, and in any case generate some reference structures to be analyzed later in more detail.

The chart here presents cities connected by more than 25 flights per week (workdays). The number is a minimum and the maximum can be much larger. London–Paris, to take the example on top of the list, has 250 flights or ten times as much. But less evident cases like Barcelona–Madrid have $\sim$ 150 and Rome–Milano $\sim$ 130.

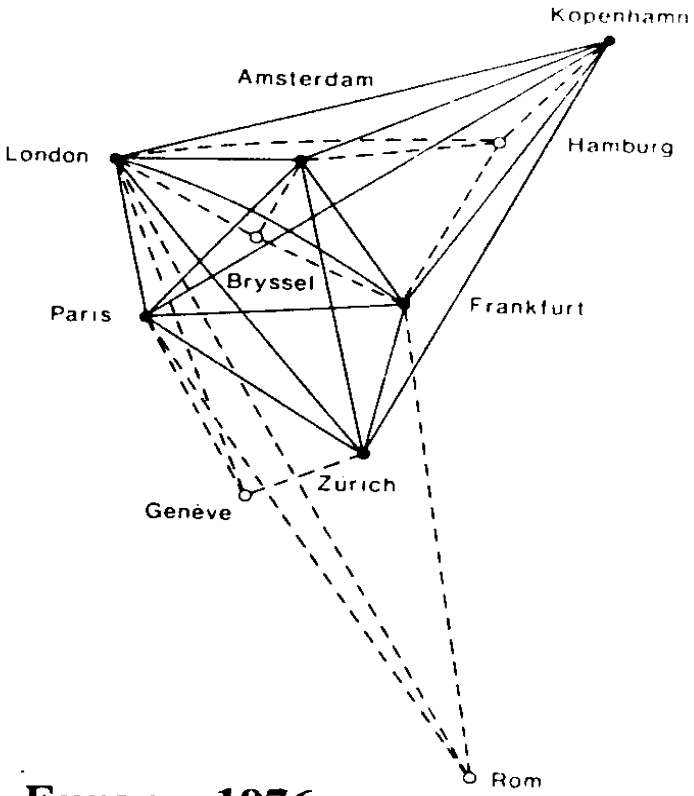
It is inside these connections that one shall look for segments suitable for a fast train link.

Figure 17.

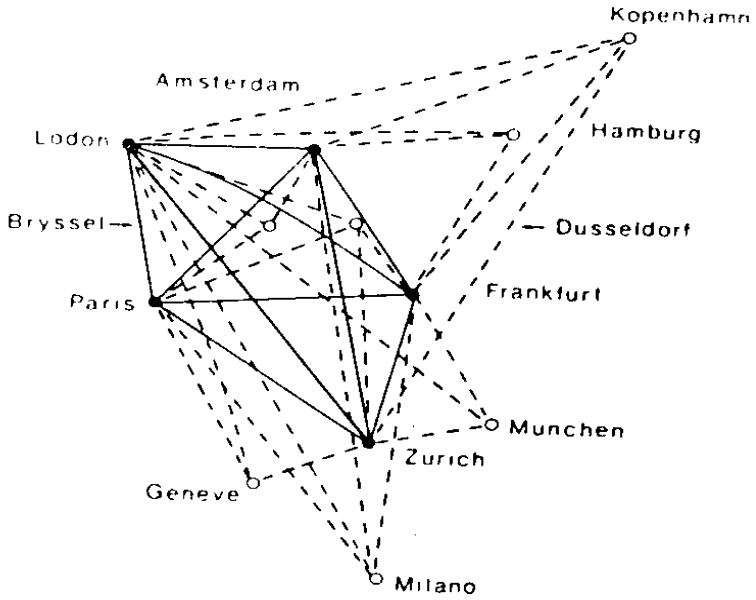
Figure 18a,b.
Central core of European business connections.

In order to select the core of these connections, U. Erlandson of the Geographic Institute of Lund University, chose the criterion of hard core putting together the centers connected with *all* the others by at least 25 flights over the five workdays of a week. The results of his analysis are reported in *Figures 18a* and *18b* in a time frame covering 1965, 1970, 1976, and 1988. The base core stays substantially the same although when one of the cities lacks only one connection (dashed lines) it can easily flip in. Milano is in fact in with the air timetables of 1991 as it has now more than 25 connections per week with Zurich.

Figure 18a.



Europa 1976.



Europa 1988.

Figure 18a,b.
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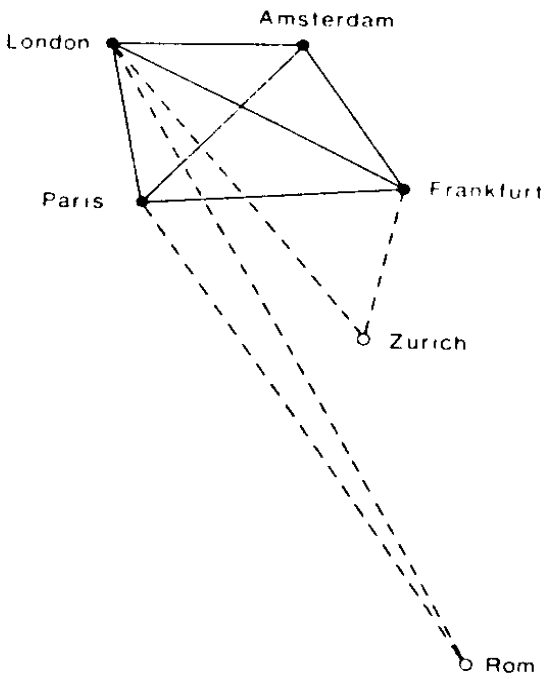
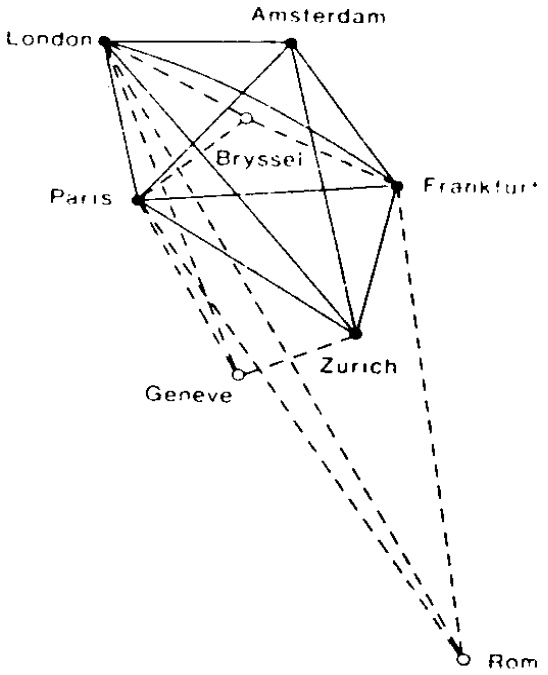
Figure 18b.



Europa 1965.



Europa 1970.

Figure 19.
A German Eperopolis.

To illustrate in detail the concept of Eperopolis, an area where one can do business and come back the same day, I report here the case of a German Eperopolis as identified by Doxiadis.

The center of the Eperopolis is the Ruhr agglomerate, and the connection includes all means of transportation. The longest tracts operate through frequent air connections (if not shuttles in a literal sense).

An existing structure like this one could be strongly reinforced, introducing in some critical segment a very fast mass transportation system.

Figure 19.

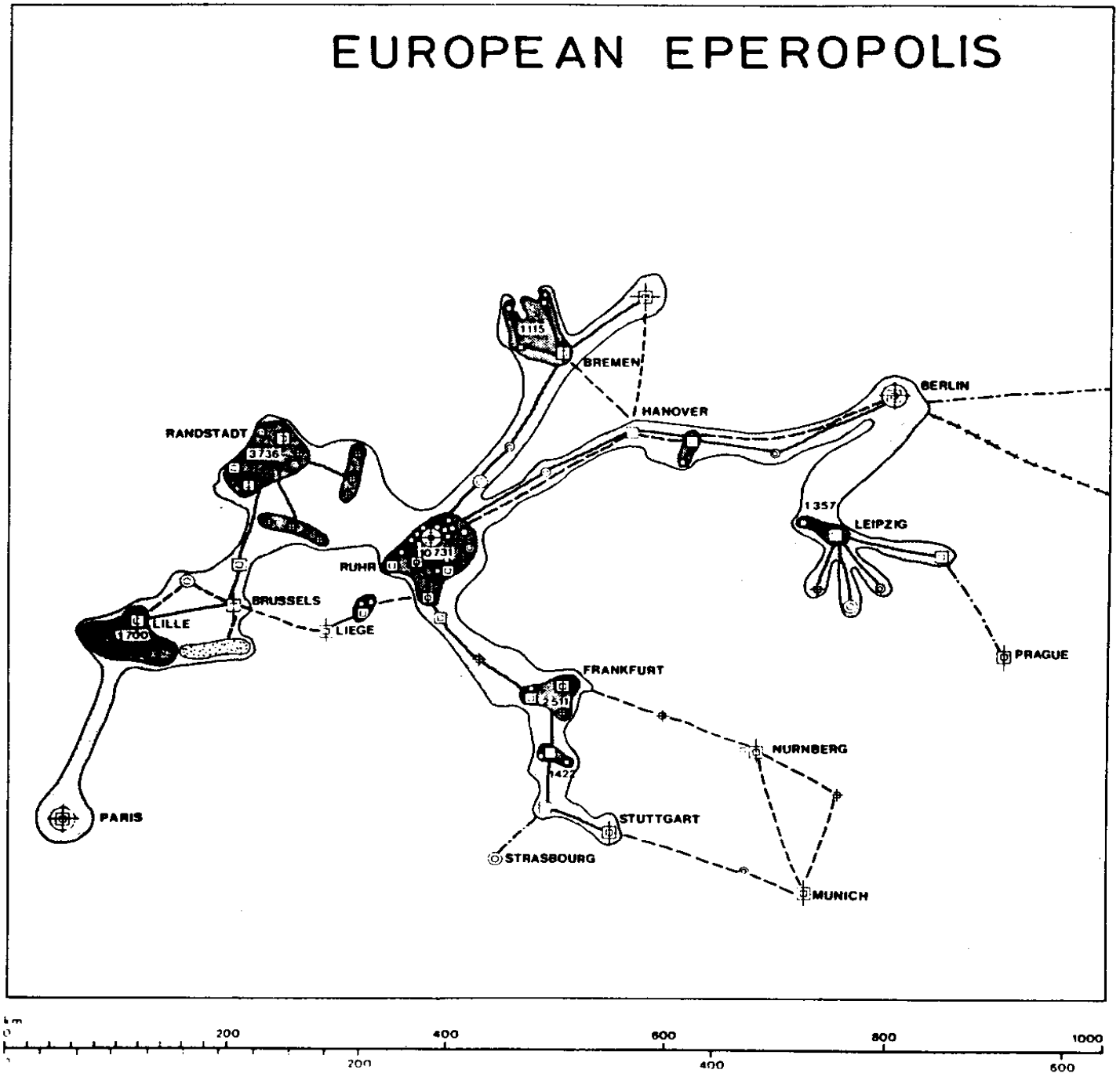

EUROPEAN EPEROPOLIS
1115
BREMEN
HANOVER
BERLIN
RANDSTADT
3736
1357
LEIPZIG
RUHR
BRUSSELS
LILLE
1700
LIEGE
PRAGUE
FRANKFURT
NURNBERG
1422
PARIS
STUTTGART
STRASBOURG
MUNICH
km
0
200
400
600
800
1000

Figure 20.

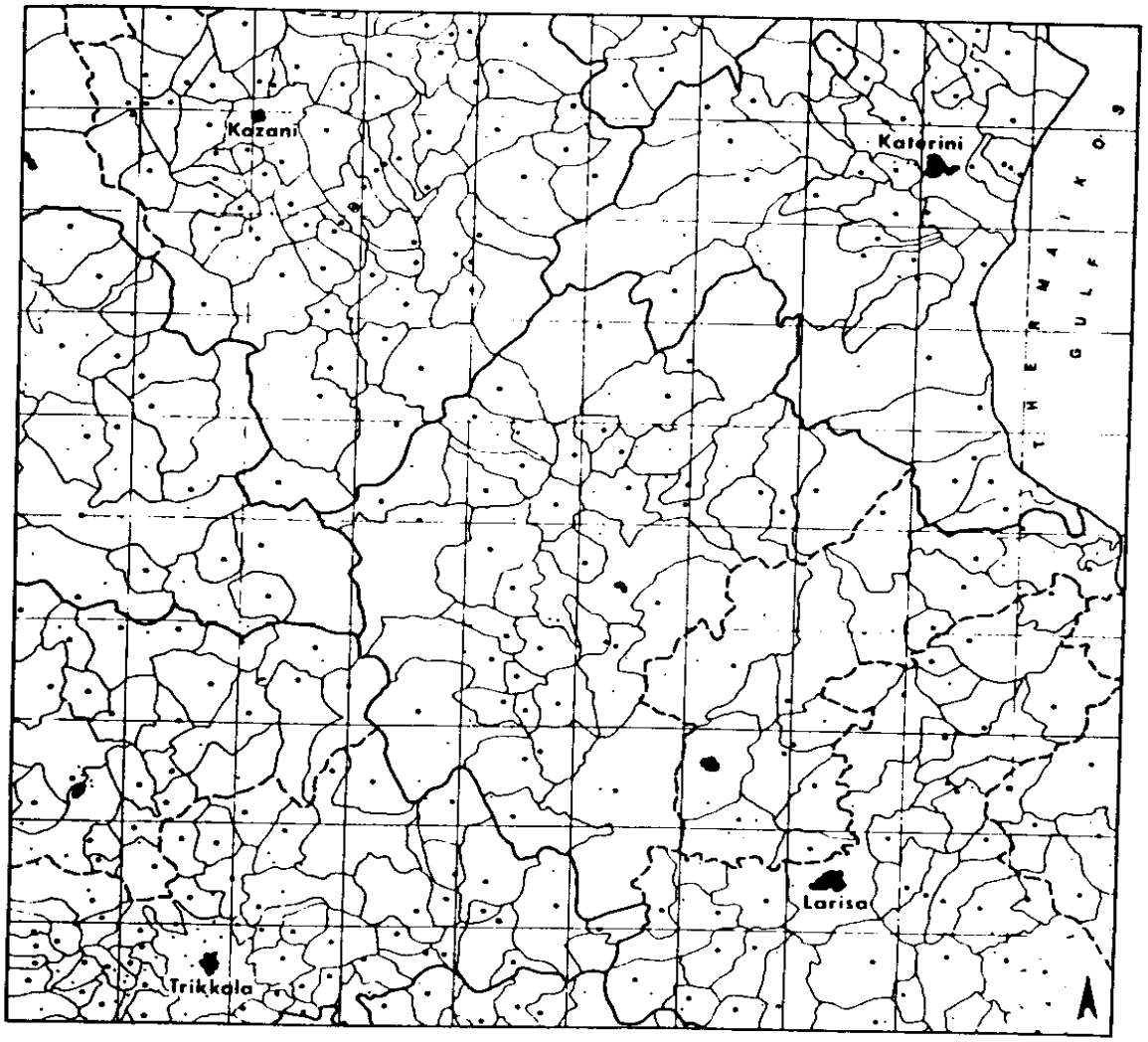
The area connected to the center, in this case a village, is defined by administrative boundaries which notify a territorial structure built up during millenia. The mean radius of these territories is about 5 km, the distance that can be traveled on foot in one hour. We find here again the principles that define the size of a city. Ancient cities, even the largest ones like Rome or Persepolis, had about 5 km diameter inside the walls as said in the legend to Fig.9.

These boundaries define *daily trips*. Normally *once a week* these villages had a market in the center of a bundle of seven villages. *Annually* there was a fair in a center far away encompassing a number of these bundles.

This historical detour is important for the purpose of establishing a strategy and a value set for TGV lines, because the *same basic anthropological drives are operative today* as it will appear in the text. The only difference in spacial scale is brought in by the higher speed in the transportation technologies of today. But the larger system tends to be homothetic to the previous ones, the ratio in speeds being the spacial coefficient.

Figure 20.

Village Patterns in Greece

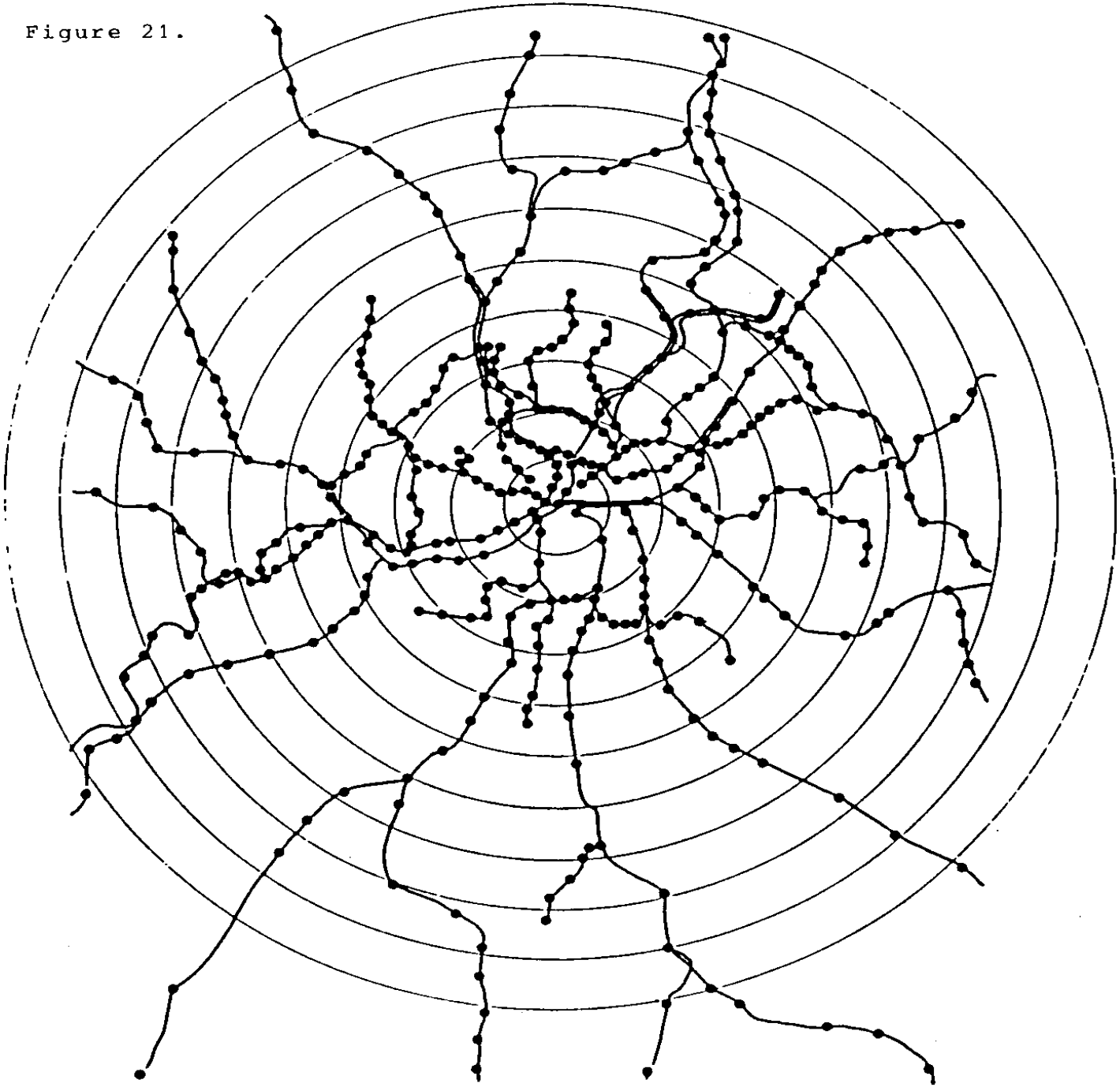


Mean area 22 km^2

Figures 21, 22.

The map of the metro of Paris is reported here in scale, with metro stations in evidence. The circles are drawn 1 km apart from the dead center. The analysis, reported in Fig.3, measures the cumulative number of stations as a function of distance from the center. A sharp knee is apparent at a radius of about 2.5 km. Inside this radius the metro stations are homogeneously distributed (at 1 km mean distance) and their density starts abruptly to fade away starting from this border. This defines a city *on foot* practically inaccessible to cars, which have a very limited utility due to low speed, separated from a city where cars progressively pick up the transport function. *This shows how an efficient public transport can substitute cars and both can mesh together.*

Figure 21.



Figures 21, 22.

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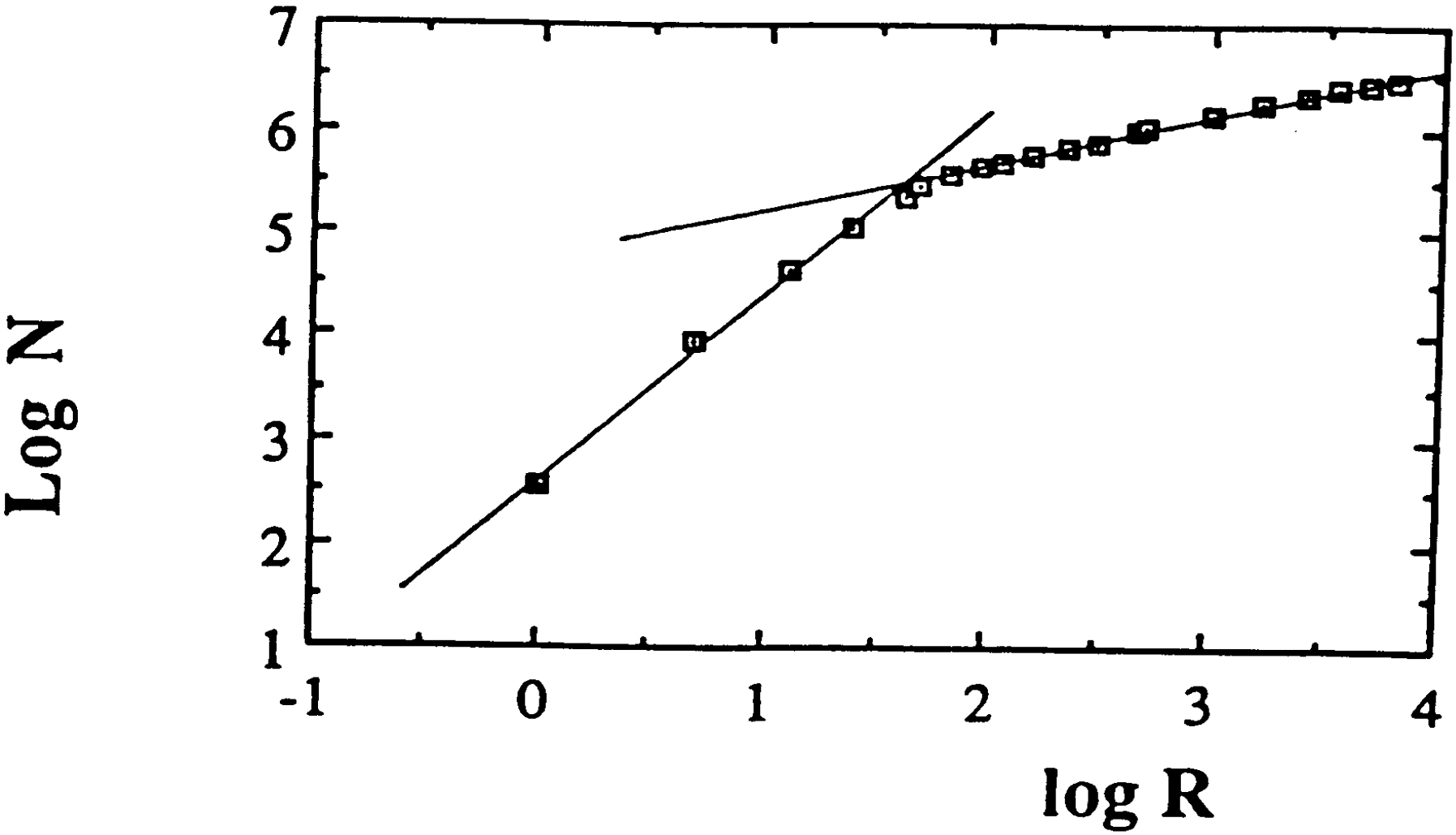


Log-log Plot of the Cumulative Number of Stations as a Function of the Distance to the r of the City. Two successive regimes may be defined, with slopes 2 and 0.47, respectively.

Figure 23.

Once cars can move, all the geography is upset. This chart shows superposed and on the same scale the commuting ranges of 11 American cities and the schematized structure of the system of greek villages with their territories. The ratio in linear size is about 9 or 10, which is the ratio of the speed of a walking man (4 to 5 km/h) to that of a car ($\sim$ 45 km/h mean). The taxonomy remains the same and the size grows homothetically with speed. It must be clear that the *number of trips* per day and their subdivision in short, medium, and long *stays the same.*

Figure 23.

Commuting Fields of Eleven American Cities

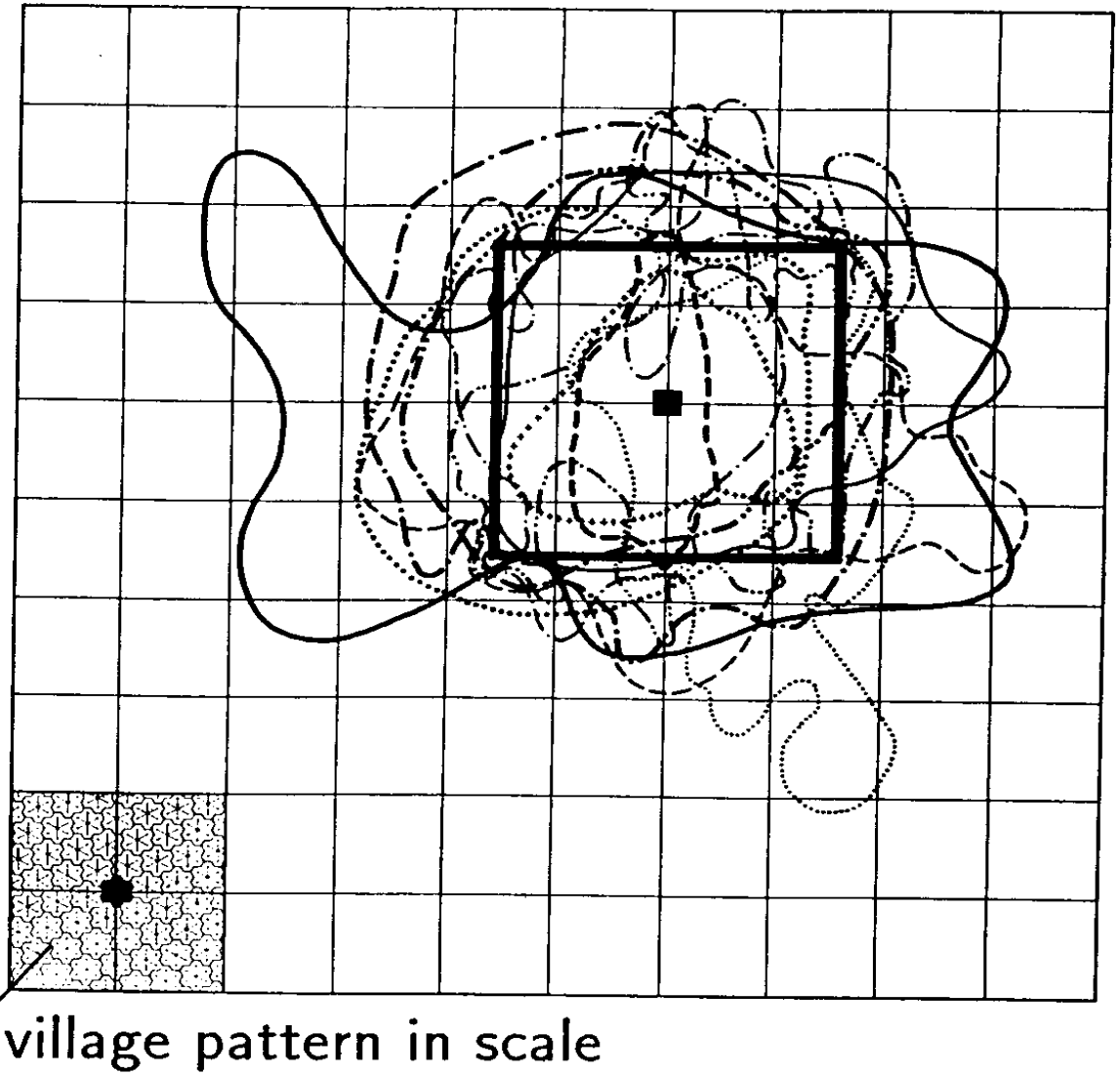


Figure 24.

As we have said in the text, long trips are rare, about two orders of magnitude less than trips in the daily territorial range. They are, however, important for keeping the macrosystem together. This trickle of traveling is channeled through *facilitated corridors*, where not only roads but also a variety of services are provided. Again a historical backview shows how stable these corridors are. The map reported here depicts the road system connecting norther to southern Europe *five centuries ago*, and is strongly reminiscent of the most important railways and motor ways of today. TGV planning should keep this historical and cultural matrix in sight, at least in terms of priorities. Incidentally, Rome is *still* isolated from northern Europe.

Figure 24.

MAIN OVERLAND ROUTES TO AND FROM ANTWERP IN THE 16th CENTURY

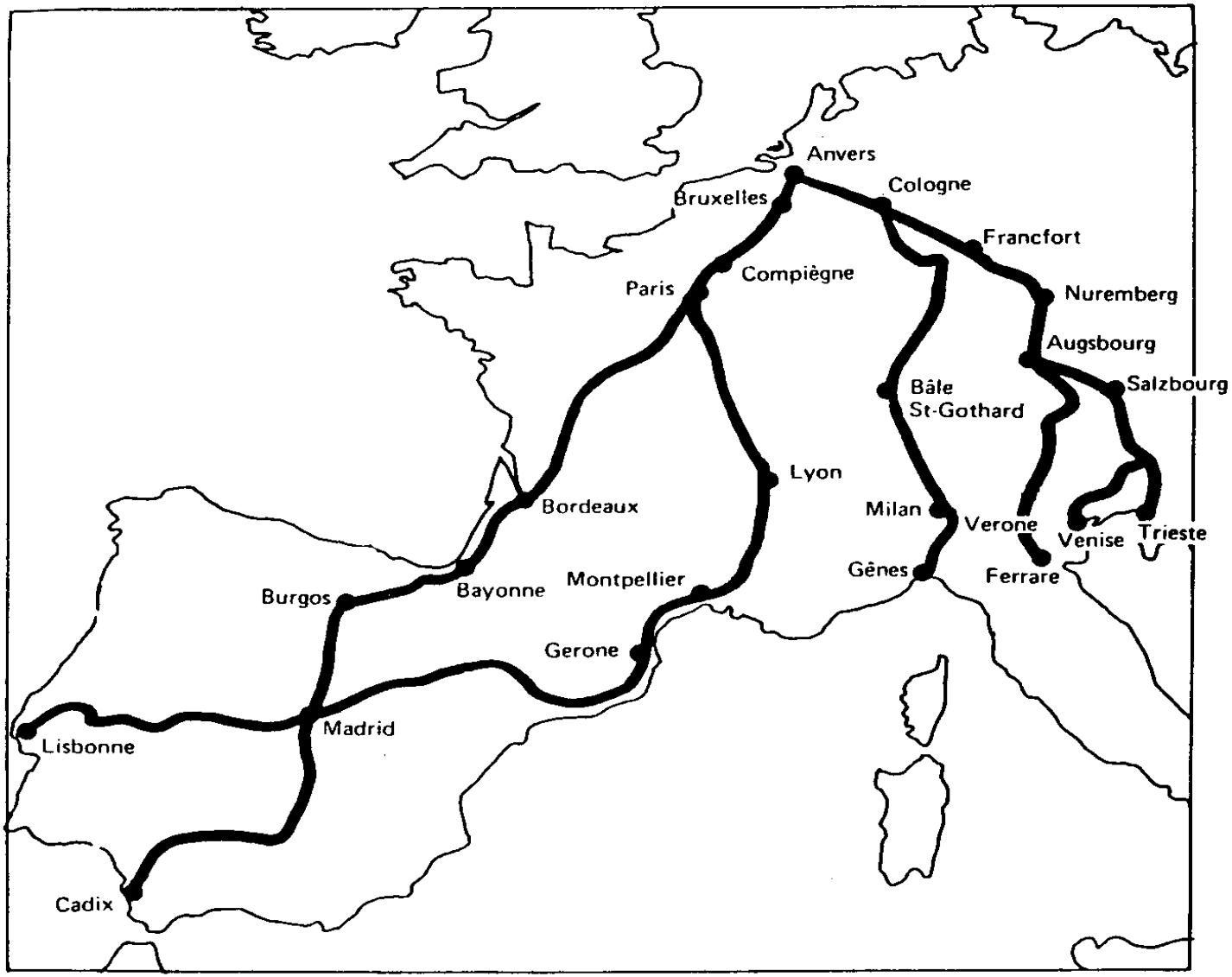


Figure 25.

This table reports in neatly interpretable terms the quantities for travel taxonomy. The tale is done for a mix of cities around Europe, but as we keep stressing, the basic structures are always the same. The difference coming from the constraints of speed and money are here relatively limited except perhaps for the use of airplanes that require a fair level of wealth. S.s.p. are short stay personal trips done for personal purposes. The other legends are self-explanatory. A detailed analysis of this table is contained in the text.

Figure 25.

Summary of Trips, by City

	No. of persons in sample	% of households with car	Number of trips per head							
			total	business	holiday	s.s.p.	car	train	bus	air
oulouse	1,373	72	12,7	2,5	2,6	7,6	11,3	0,8	0,2	0,4
enève	1,119	65	9,5	2,3	3,5	3,7	6,2	1,8	-	1,5
small rench towns	1,601	79	8.4	1,5	2,2	4,7	7,5	0,6	0,2	0,1
üsseldorf	1,208	46	7,3	2,8	2,0	2,5	5,4	1,1	0,1	0,7
isboa	1,549	47	6,8	1,3	1,9	3,6	5,1	0,7	0,7	0,3
inz	1,408	55	6,5	3,0	1,5	2,0	4,8	1,0	0,4	0,3
orino	1,533	71	6,5	1,1	2,1	3,3	4,6	1,5	0,2	0,2
en Haag	1,941	63	6,4	0,9	1,5	4,0	5,2	0,7	0,1	0,4
ruges	1,743	65	6,2	2,5	0,9	2,2	4,6	1,2	0,2	0,2
alencia	1,729	47	3,6	0,7	0,8	2,1	2,9	0,3	0,3	0,1

Figure 26.

This chart reports the modal split for *business trips* in terms of transport technology. The dominance of the car for short trips below 200–300 km is evident. The car in fact provides sufficiently low, door-to-door, travel time, on top of being more comfortable and for a company more "representative" than any other transport mode (if chauffeured). Company jets do better but do not make statistics yet. The fact that cars, trains, and planes meet at about 500 km to share equally the traffic, should not rise excessive hopes for the *volume* of traffic TGV can steal from planes. Most trips are, in fact, below 200 km, leaving the lion share to the car, unless TGV is conceived for *short distances.*

Figure 26.

Business trips - modal split

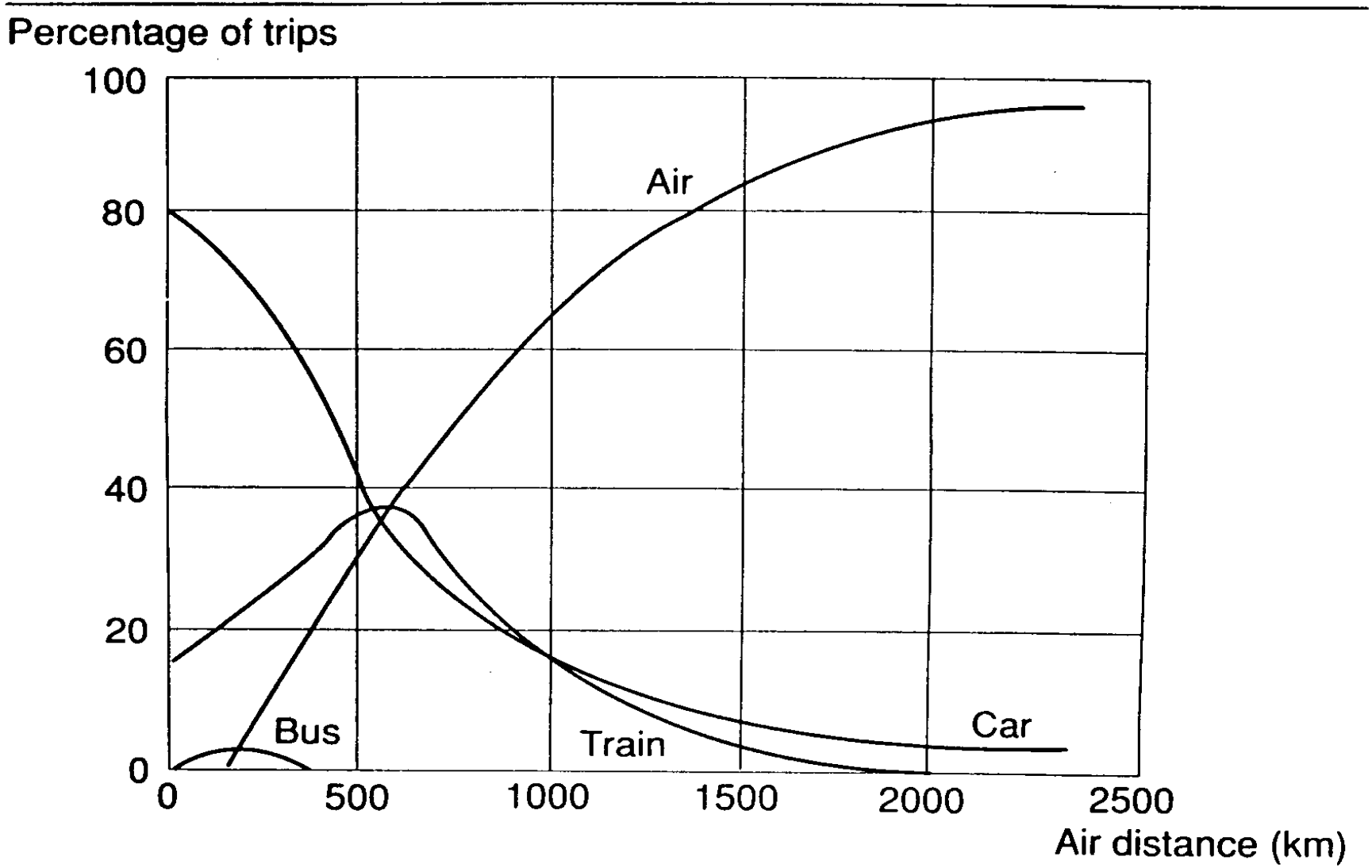


Figure 27.

Measuring the speeds of intercity trains in Germany (in terms of air distance between stops) we get this barchart showing a mean speed of about 65 km/h. It is true that in some cases the top is 95 km/h, but the panorama is bleak. It is clear that speed (and frequency) is the weak point of the railway system, and the suggestion to improve it explicitating the potential of present technologies make sense on paper. But the calcified organization of the rail system makes that doubtful. This raises the important questions of whether railways should incorporate TGV or whether the system should run independently. As many lines are constructed *ex-novo* and travel point to point, the second alternative appears feasible also formally.

Figure 27.

QUALITY OF SERVICE PROVISION IN DB LONG-DISTANCE RAIL PASSENGER TRANSPORT

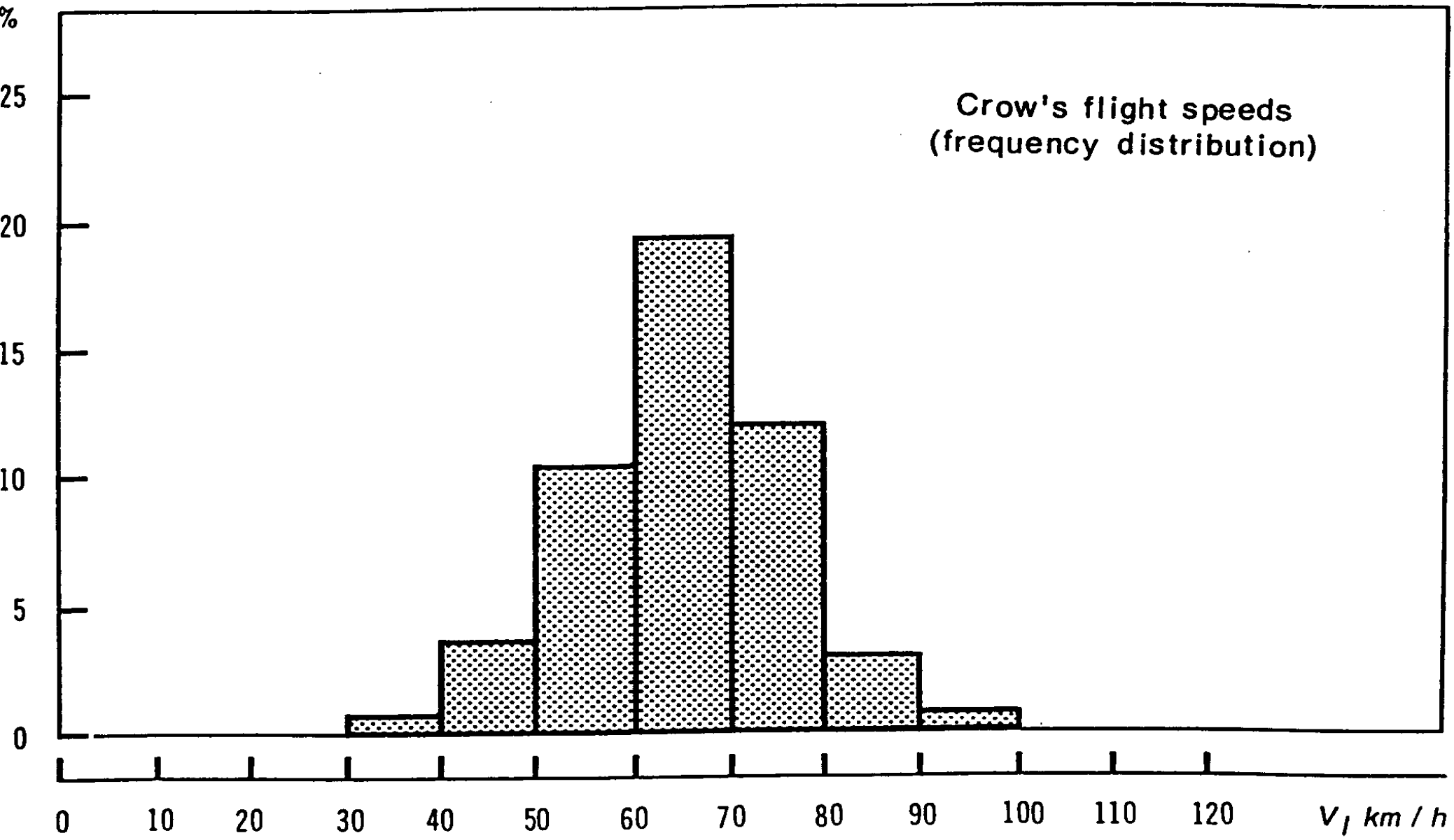


Figure 28.

Holidays represent the very long trip of our villagers going to the yearly fair. It is done once a year, when possible. The analysis in Valencia and Bruges (Fig.25) shows their citizens making a holiday every two years (trips are counted one-way). For households holding cars the car is the right holder of the familiar package, neatly substituting the ox cart of the villagers, with family goods and provisions perched on top and dog trotting underneath.

Trains emerge in the 1000 km range and planes beyond that. The possibility to use planes for that purpose comes mainly from the strong reduction in prices made possible by group tariffs and charters. Price is the most important deterrent in using airplanes over Europe. Any intercountry journey costs the equivalent of one month basic salary, and falls outside the TMB of even middle classes. If air fares were nearer to the American ones (about 1/5) the chances for long-distance TGV would be very dim.

Figure 28.

HOLIDAY TRIPS - MODAL SPLIT

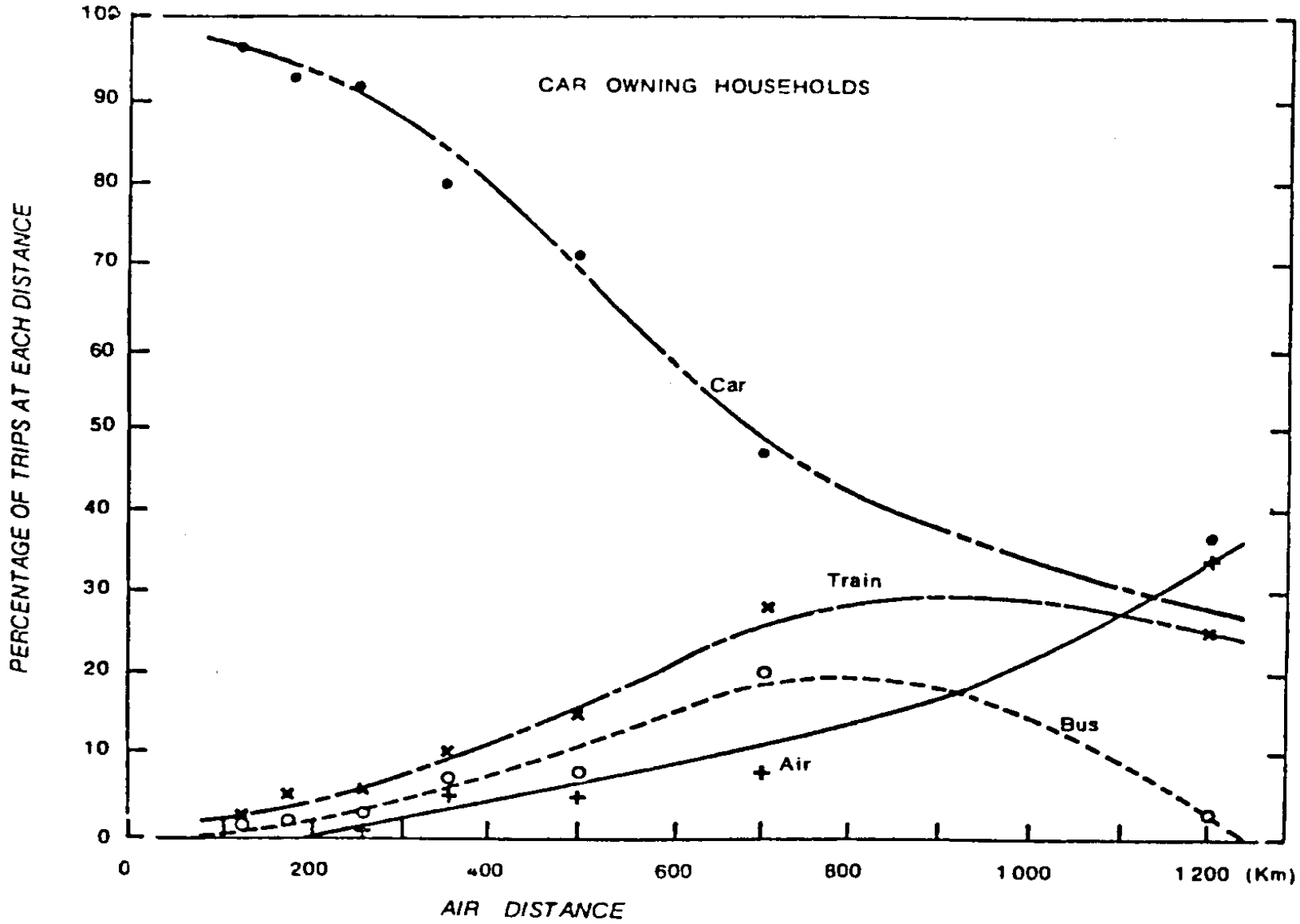


Figure 29.

As buses may provide a package configuration similar to cars, one might have expected it to substitute cars for non car-owning households. In fact, even these households manage to travel by car, equally shared with trains for the short distances below 300 km, which are anyway the most frequented. Trains dominate in all intermediate distances (300 to 1300 km). The only point is that non car-owning households are becoming rare in Europe.

Figure 29.

HOLIDAY TRIPS - MODAL SPLIT

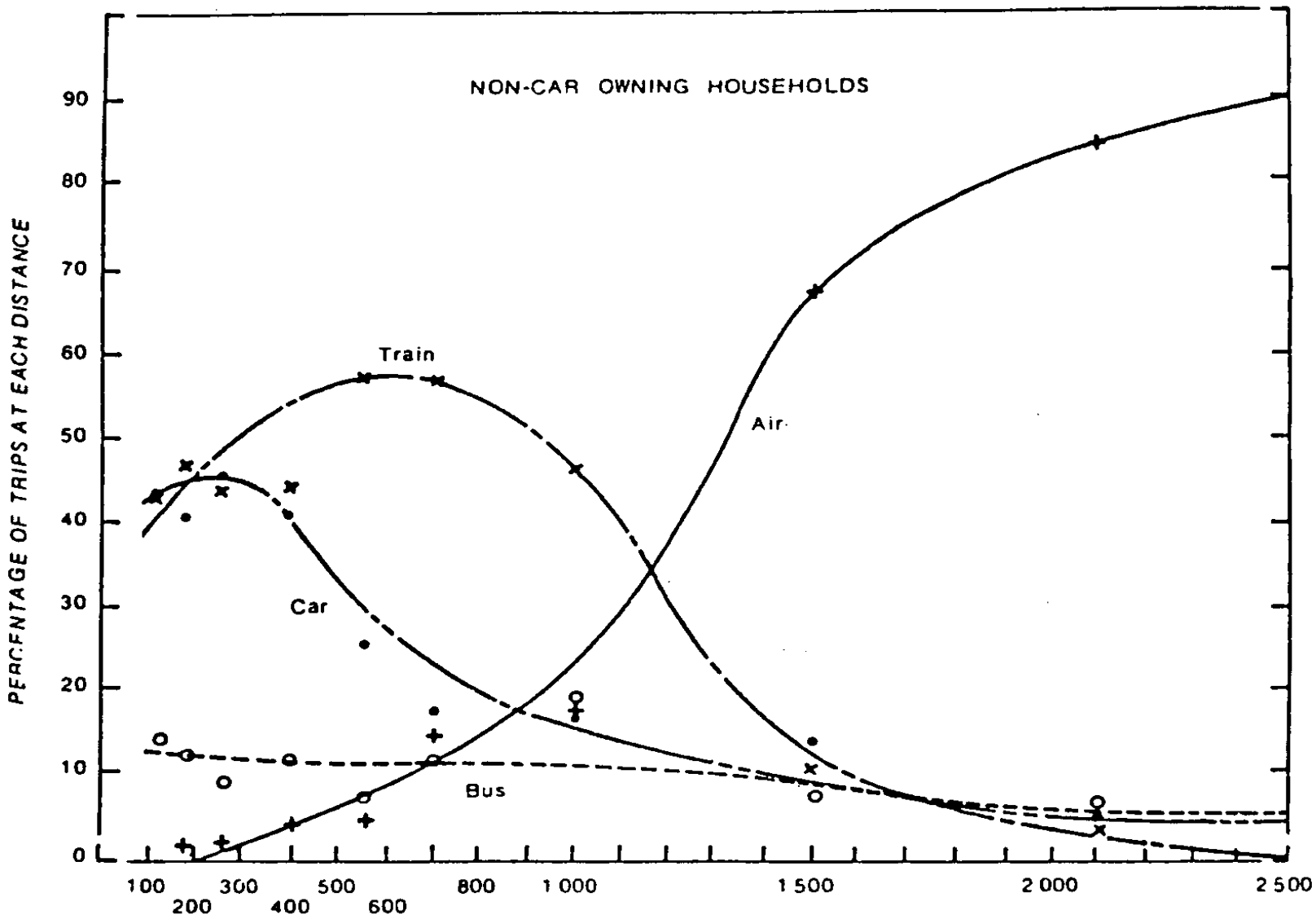


Figure 30.

The largest number of trips (50%, as seen in Fig.25) are done for short-stay personal trips. Great attention should be devoted then to this potentially large market. We see here the car dominating up to 1000 km, for the families owning cars, with comparably very little share of the train at all distances. It must be clear that most of these trips are in fact done by car-owning households. Consequently, TGVs should compete with cars again at all distances but specially at the short ones. As we will see in Fig.23, 95% of these trips are below 200 km.

Figure 30.

SHORT STAY PERSONAL TRIPS - MODAL SPLIT

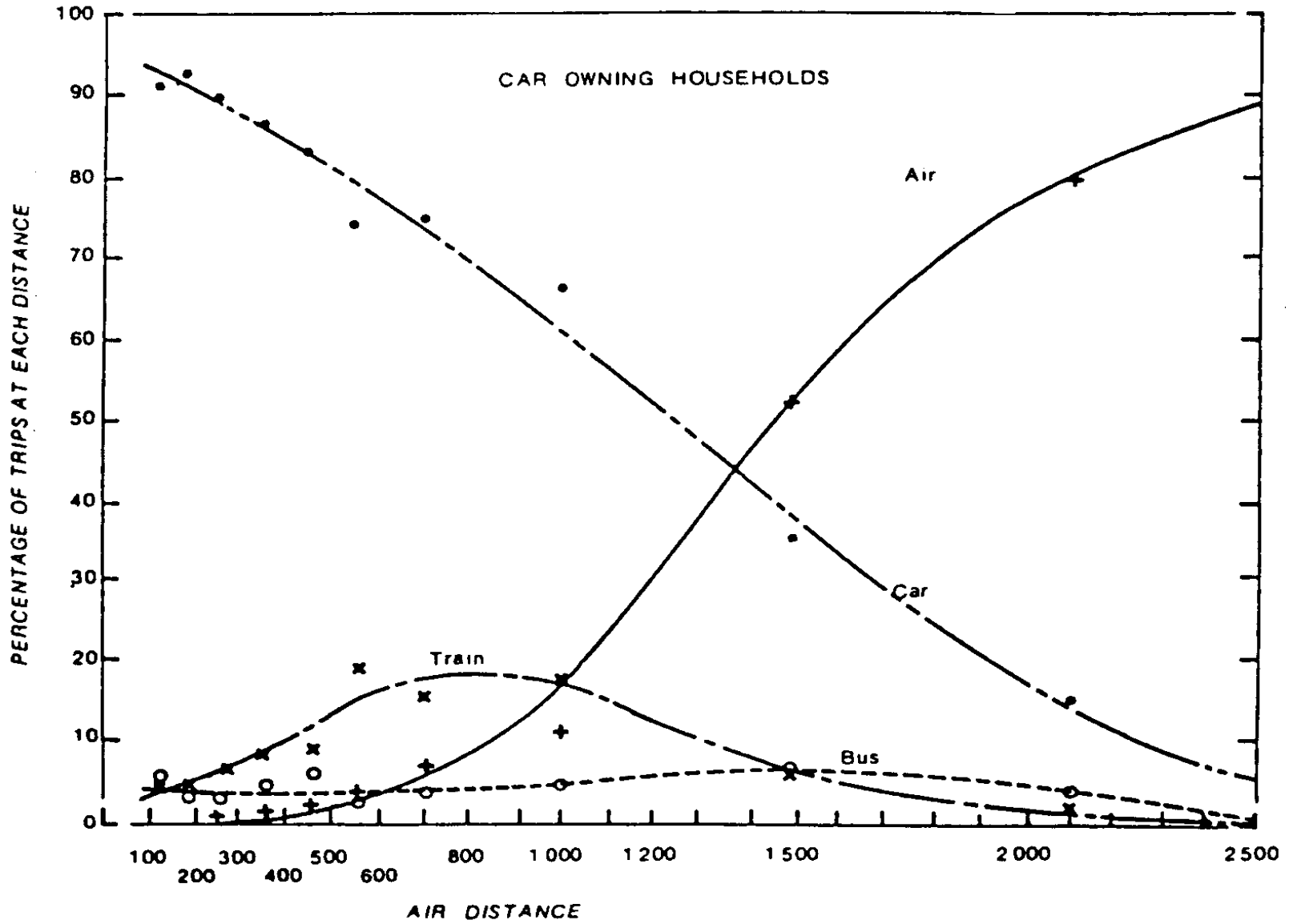


Figure 31.

For persons belonging to households not owning a car, the short-stay personal trips in the range of interest (<200 km) are equally shared between trains and cars. The percentage by air is negligible, as we will see in Fig.32, due to the rapid fall-off of trip rate with distance.

Figure 31.

SHORT STAY PERSONAL TRIPS - MODAL SPLIT

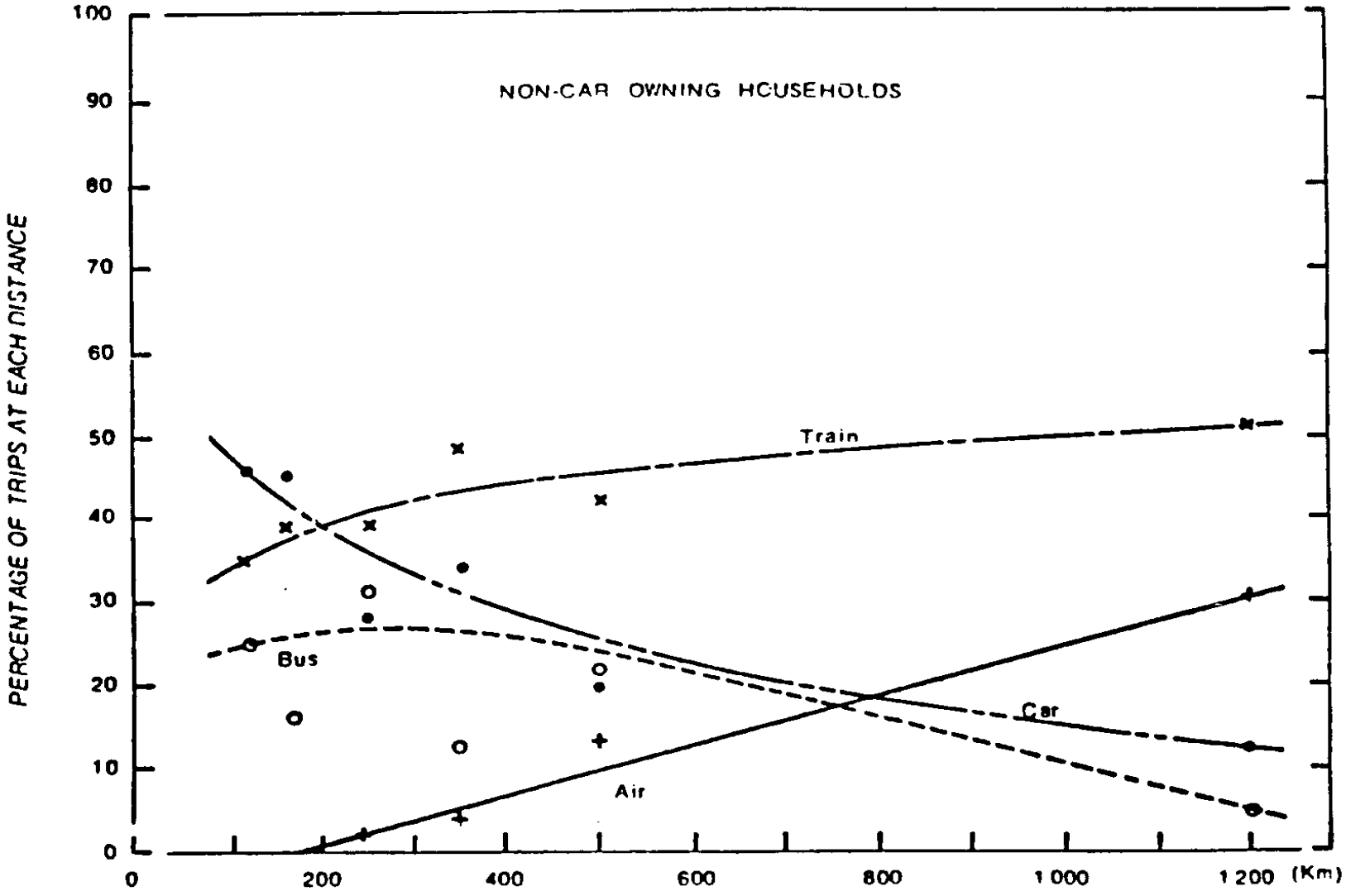
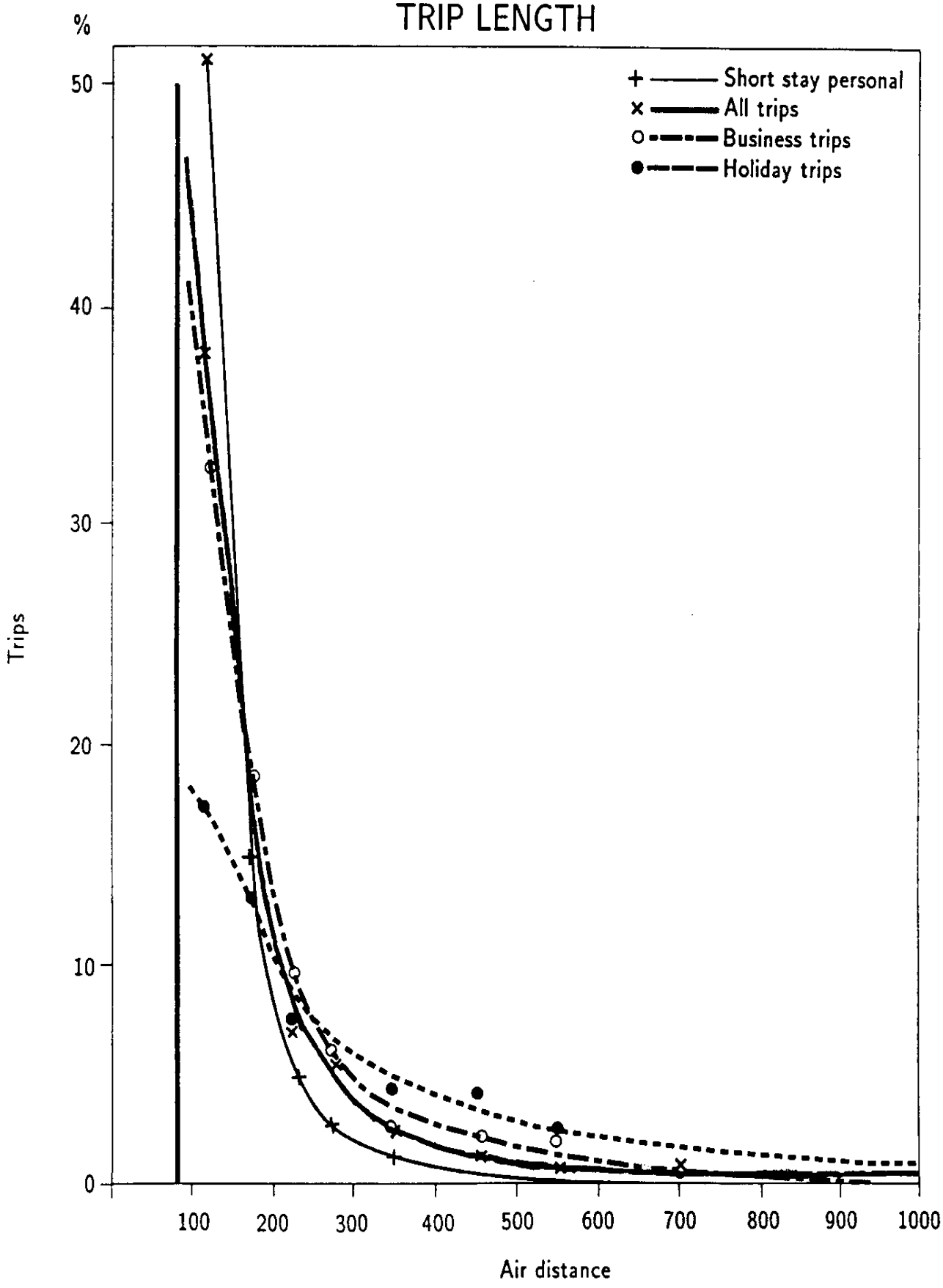


Figure 32.

This is the most important chart in the list. It shows the very fast fade-out of trip rate with distance. For business trips, 90% are done below 250 km, short-stay personal has a 90% cut-off at 200 km, the same for holiday trips and for all trips summed up.

In other words, for taking markets from other means of transport the *TGV should probably forget the large integrated European network and concentrate on the 200 km range.* The Italian Pendolino has faced the problem in terms of reduced occupancy for the non-stop stretch Milano–Rome. Occupancy grew dramatically with the Bologna and Florence stops, due to pick up of local traffic, where the one-hour trip time appears very convenient for business travel.

Figure 32.


TRIP LENGTH
%
50
40
30
20
10
0
Trips
Short stay personal
All trips
Business trips
Holiday trips
100
200
300
400
500
600
700
800
900
1000
Air distance

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