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ELEMENTS FOR A GEOGRAPHY OF TELECOMMUNICATION*

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GEOGRAPHY AND TELECOMMUNICATION

The advent of new relational technologies (telecommunications, rapid trasports) is playing a part in the establishment of a new society which has been called the post-industrial age (Bell, 1973), or the technetronic age (Brzezinski, 1971), or, more recently, the third wave (Toffler, 1980). Telecommunications are helping to remove the obstacle of distance between individuals who are far away. By facilitating the circulation of information, they are playing a decisive role in the present trend toward an international economy and are contributing to modification in relationship between men and space.

The introduction of telecommunication techniques alters the time and space scales. Distance hardly means anything any more and even time has been brought under control. The planet seems to have shrunk surprisingly — less time is needed to contact any point on the globe than was needed less than a century ago to contact towns and villages from the capital of an average-size European country.

A new social space-time structure is presently in the process of rapid development although this structure was conceived more than a century ago and its importance has gradually been asserting itself. Nations and, at least to the same extent, the most powerful multi-national companies in the electronic field, set up and control this new social space-time structure.

The installation of various telecommunication networks and their increasing role in economic and social life have made it possible to speak of "wired-up" societies or cities. Also, the boom in the use of the telephone, the compunication, and the new telecommunication services will introduce further constraints on any regional planning decision (especially when this concerns decentralization of service and administration jobs and facilities).

Thus, telecommunications cannot be viewed as being independent of geographical space. May we think paradoxically that the nature of links made by telecommunications possibly imply a limited importance for geographical

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questions? Of course, the answer is no. The analysis of telephone equipment distribution shows clearly that the demand is a function of regional disparities which already exist (Pautrat, 1978). This conclusion is also correct to other types of telecommunication equipment , for example compunication and facsimile terminals (Bakis, 1975 a, b, 1979 a, b,).

The socio-professional characteristics and the nature of regional activities are thus clearly shown to be at the origin of regional differences in the distribution of equipment. The question, in that perspective, is as following: can telecommunication play any part in the structuration of the geographical space? Our recent study on the internal communications of the IBM Company (Bakis, 1980a) convinced us that telecommunication systems could have a very well-defined structuring effects — at least within large organizations. Production, maintenance, internal professional training and marketing policy may be directly influenced by the use made of teleprocessing.

It seems quite probable that the true picture is somewhere between total structuration (which also implies at least partial destructuration of what exists and restructuration as a function of other criteria) and persistence of existing characteristics. It does seem possible to accept the hypothesis of actual structuration in certain closed systems such as administrations or large companies. On the other hand, as soon as one studies an open space, subject to a thousand interacting influences such as a city or a region, it is then more arbitrary and more risky to try to determine the structuration brought about by telecommunications. One must also reckon with inertia effects and constraints of various kinds. If effects can be observed, it seems unlikely and even somewhat naive to pretend there is no differentiation according to site, that geography is now "transparent".

Understanding the new structuration of space taking place should be one of the tasks to which the geographer together with specialists from other disciplines and government officials should devote himself.

Despite its importance, only a few studies have been carried out on that question. Just as sociologists and economists prefer to study the influence of television and radio rather than that of the telephone, teleprocessing, telex or new services, geographers for their part generally give little space in their works to telecommunications.

One of the main reasons of this lack of interest may be found in the abstract nature of the phenomenon. The geographer, a man of the field, is accustomed to have an almost fleshly contact with the object of his study. Whereas transportation infrastructures are visible parts of the landscape and thus even tangible, the same is not true of telecommunication infrastructure which at first sight do not stand out when they are visible and are often even outside the field of vision (underground cables, satellites). Even when the telecommunication phenomenom is visible in the landscape one can then see, as will be shown later, only the top of the iceberg. Public expenditures in nations devoted to telecommunication investments are sometimes very important. However, they have no tangible counterpart in the landscape and in the experience of each and every one of us as do investments in transportation infrastructure: we travel for hours on the motorway, we go to the airport and we

take the train. Efforts are required then.

And yet telecommunications also make their own kind of mark on the landscape with cables, microwave towers and various types of aerials which are all common place features of the landscape. However, the geographer of the rural environment for microwave towers, do not attach any special importance to the aerials he sees. Included as objects in his field of study, they had to be neglected because *they transcended his own concept of space.* Thus, the mere study of the landscape could have led to a geographical study of telecommunications. What is more, a certain amount of research work had already pointed to the existence of the question and the interest in it.

In 1935, W. Christaller pointed out that an index of telephone equipment could supply much useful information on the phenomenon of "centrality". In 1955, Labasse emphasized the importance of an analysis of telecommunications for geographers: telephone calls "cover the whole game of human relations and fully satisfy the objective and quantitative requirements of a detailed analysis" (Labasse, 1955).

Still more recently, various articles have made some up-to-date contributions and a literature is beginning to fill out. The importance of the subject has thus been noticed. Although it has been mentioned several times, it did not lead to any systematic program of research. It was in fact only by accident that geographers began the analysis of telecommunications: a limited study within work on a completely different question, or articles by people whose curiosity had been aroused by a limited subject. The situation seems to have just begun to change. The boom in compunication has certainly contributed in drawing the attention of the general public to these questions and there are now many research centres carrying out work on this aspect of geography.

It is thus perhaps more necessary than ever to attempt to define the field of study. This is what we shall try to do here by outlining some lines of research. We cannot of course hope to be exhaustive. We shall only mention some topics worthy of interest.

DATA ABOUT TELECOMMUNICATION: AN INSTRUMENT FOR GEOGRAPHICAL ANALYSIS

Some geographical approaches to telecommunications may be schematically described as "the role of geography in telecommunications". Analysis of the geographical distribution of equipment and of the flows of data makes it possible to specify in particular the areas where geography comes in — regional disparties, unequal international development, relations between spaces with connection between sub-spaces. Whether we are considering past geography or the present distribution of activities in the country, the infrastructure and equipment are in fact set up as a function of the existing situation.

This remark carries even more weight at the inception of the network when private companies, anxious to get the maximum return on their investments, were given the task of setting up transmission channels, switching centres and

terminal equipment. It is, however, still valid despite the "public service" constraint on telecommunication equipment and consumption, although it might be less so as far as the actual networks are concerned.

The study of telecommunications, from this point of view, thus consists of analysing one index among others, enabling us to approach the existing situation studied by the geographer.

Equipment and Infrastructure Analysis Approach

An analysis of the geographical distribution of equipment would permit us to assess (in the light of the telecommunication index) the exact weighting factor for spaces. What are, in particular, the nature and importance of regional differences viewed from the point of view of relational tools?

The various types of equipment do not have the same significance. The degree to which the regions are equipped with some kind of equipment or another and which must be related to the flows analysis will have a different meaning according to whether we are considering:

(1) telephones (relations between spaces, between professional and domestic subscribers taken together);

(2) telex (relations between establishments whose business requires rapid and reliable communication);

(3) facsimile (ability to transmit short document manuscripts, drawings, etc. without waiting for the post);

(4) teleprocessing (implies certain dependence relations while revealing the concentration of certain activities and the degree of integration of the regions in the national and international economy).

Apart from the distribution of equipment and systems, an analysis of the differences between regional spaces and their respective sub-spaces must consider the differences in the consumption in telecommunications. Furthermore, we must try to assess the differences existing -or which may exist- concerning accessibility to the system. This question implies on the one hand a technical analysis, but, on the other, even more an analysis of the possible differences in the way the rate is fixed from one region to another.

After having assembled a set of elements on the inequalities concerning equipment, consumption and access to the systems, the geographer must give an explanation of the inequalities putting these remarks within a perspective with a set of socioeconomic parameters which might provide some answers.

Analysis of the Flow of Telecommunication

The first problem concerns the data. difficulty of obtaining usable statistics is certainly at the root of the lack of research devoted to these questions. Also it is a fact that the work which has been done has often been carried out on the basis of statistics specially drawn up for the purpose of the research. The comparison of data from different sources is of course very difficult.

The second problem concerns the interpretation of such data. Without being too extensive on that point, let us note that in order to be able to give a

satisfactory interpretation to the statistics concerning telephone traffic, and avoid dealing with flows which cannot be interpreted, we must know the direction of flows, the structure (who is in control: headquater, plant), the nature (categories) of the message, the correspondance between telecommunication spaces and those of other administrations, if different, in order to make possible statistical comparisons.

Articulation between spaces and sub-spaces

An analysis of the flows of communication would enable us to reveal or to measure the relations between various territorial units. It is therefore of interest in developing research on the relations between spaces and sub-spaces.

Thus if we take the planetary space as a basis, we can analyse the relations existing at the level of national sub-spaces. We shall especially be able to comprehend the relations of one country with other countries, and all these relations may provide a wealth of information on the different ways of exchanging communication with various types of countries. Going one level further down into sub-spaces, and changing the scale at the same time, we shall be dealing with regions: relations between regions or more specifically, relations between large towns in the regions.

The general problem of defining the areas of influence of towns, the study of the limits and extent of these areas, and the calculation of the degree of centrality in urban centres, may be included in an articulation between spaces and sub-spaces. This more general subject actually involves the question of hierarchy. The value based on telephone traffic statistics has been confirmed by Schwab. In his study of the urban hierarchy of Alsace based on telephone statistics, he was able to note that "the results we have obtained are in conformity with those that M. Rochefort had found by his method. Telephone statistics are an overall criteria with which it is possible to grasp the urban system in its totality, i.e. urban centrality and influence exerted by the centres on their environment" (Schwab, 1968).

However, Pellegrini (1980) draws attention to the present limits of validity of the telephone density index as a measure of centrality and degree of urbanization of a population. He puts forward the hypothesis that the value of the telephone index is only maintained in poor countries. Such a statement implies that this telephone index is no longer meaningful in a country with a high density of telecommunication equipment.

This theoretical debate eserves to be fed with detailed analyses. On the one hand, it would be useful to describe the present status of the debate by analysing the position of W. Christaller in detail, and listing the many criticisms that have been made against him. His method of determining central sites has even been considered as a mere simplification, rather than as an effective way of measuring centrality.

On the other hand, it would be desirable to clarify the debate by defining what comes under the general study of centrality (and any criticism on this point could be justified) and what comes under a simple analysis of telecommunication flows as such. If perhaps we restrict the analysis of telecommunication flows to a meaningful field (which has to be defined

scientifically) it would be possible to avoid the pitfall of the intrinsic timitations in the index. This analysis, more modest in its ambitions, would then be combined with analysis of other indices (commercial or administrative attraction, etc.) for possible inclusion as a part of a new method for determining central sites.

Studying the General Organization of Relations

The analysis of telephone flows may be considered as the result of the amount and structure of equipment and of the socio-economic size and structure in the origin and destination modes. We can thus completely expose the spatial organization of socio-economic structures, or at least get a good idea of it, from an examination of the statistics provided by telephone flows. The analysis of these flows should also be supplemented by the other kinds of telecommunication flows, especially compunication and telex which could throw light on the geography of decision-making processes.

The importance of the transportation-telecommunination system seems quite clear. Probably, it is by including telecommunication in a context of communication that the phenomenon has the most geographical significance. To summarize this statement by a formula, we could say that the geography of telecommunications is, after all, part of the geography of communications.

This issue deserves further exploration. Perhaps we should look for a definition of the geography of telecommunications rather like Wolkowitsch who defined the object of the geography of transportation as "the knowledge of transportation systems meeting the demand for moving men and materials within a given space, i.e. city, country or continent. A transportation system consists of a series of networks each corresponding to the techniques used (road network, pipelines, etc.). The requirements of the analysis may lead to discussing one network but the equipment of a nation must be measured by the transport system which serves it. There is in fact a great diversity of transport systems available on the face of the earth" (Wolkowitsch, 1973). We could, after all, say the same or nearly the same about telecommunications.

The analysis of telephone flows thus throws some light on questions which concern geographers. The articulations between spaces and sub-spaces, the demarcation of the areas of influence of towns, the study of the limits and extent of these areas, the calculation of the degree of centrality of urban centres and the general organization of communications are all subjects which have already been studied. However the unsystematic nature of the work done could be corrected by a clear conciousness of the interest presented by the method (for which we must define the areas of applicability and the limitations), and by closer collaboration between social scientists and the administrations of telecommunication systems.

THE GEOGRAPHICAL CONSEQUENCES OF TELECOMMUNICATIONS

An analysis of the influence of telecommunications on the organization of space would enable us to answer two main questions: what are the effects caused by the telecommunications which are inscribed in the geographical space? and to what extent are these effects destructuring on the one hand,

and restructuring on the other?

The study of what we have called the role of telecommunications in geography comprises various lines of research. The field is actually quite vast. For example, it includes:

(1) analysis of the change in time and space scales following new technological possibilities;

(2) impact on the localisation of activities (production, service industries, control, geography of decision-making processes);

(3) influence on urbanization and the relations between telecommunication and the phenomenon of centrality;

(4) influence on the structure of firms and in particular, on the organization of inter-functional liaisons (production, marketing, research, management, etc.);

(5) analysis of the emergence of a new relational world space which certainly seems to be that of a new international industrial and economic order.

This list does not pretend to be exhaustive but it does give an idea of the scope of the field of research.

Change in the Time and Space Scales

General Studies

A recapitulative and historical study of the development of communication methods could be based on the growing release of men from the constraints imposed by time and space. The relational space between human societies (and individuals) was built on the technology available, i.e.: chariot, domestication of the camel and the horse; the progress of navigation; the advent of the railway, rapidly followed by that of the telegraph which brought about the introduction of a new relational frame of reference; and the spread in the use of private vehicles and of the telephone which accentuated the tendency toward this relational frame of reference. These days, with the diversification of telecommunications and rapid means of transport (rapid business trains, air transport, motorways, etc.), it certainly seems that we are approaching near and near to considerable — if not total — freedom from the constraints of time and space.

Of course these constraints may one day come back and affect us even more than before if traffic problems develop for some reason or other — traffic jams, breakdown, war and so on. It would be a curious reintroduction of distance and time, and the difficulties would greater than now, because of new

The cost of communications was for a long time proportional to distance, and it is still today, although we may note the trend towards the emancipation from distance. It actually depended on the cost of the wires through which the message was sent, as well as on the cost of associated equipment (repeaters and amplifiers which have to be spaced all the way down the cable in order to avoid loss of signal strength). Now, with the improvement in transmission methods, the cost of the actual transmission has become progressively negligible within the total cost of telecommunication unlike switching and local distribution. We can imagine that rather than the big inter-urban and international channels, it is the installation and maintenance of the vast local

network (from exchange site to the subscribers) which accounts for the greatest part of the expenditures.

To contact some point on the globe will finally cost just a little more than if we contacted a point not very far away, for example, a few tens of kilometers. In case of a satellite, the distance to earth is the same both ways. The location of the two subscribers has no effect on the lenght of the distance covered by the signals.

This, together with the spread of easy access to the telecommunication systems, takes us back to a more traditional geography, where the actual position with respect to transportation arteries counted less than the qualities of the sites themselves (for example, property of land). The question of proximity, which plays an important part in geography, can henceforth no longer be considered as absolutely vital. Furthermore, for activities such as those to do with the use and processing of data (financial and administrative establishments, etc.), the position of the site of installation is no longer fundamental; on the contrary, it is becoming subordinated to the properties of the site itself, i.e. the possibility of connection to telecommunication systems, resources in man-power, existence of leisure facilities nearby and so on. The importance of mental images of life in far-away places reached by telecommunications is bound to bring about *a certain modification of the perception of space.* It is not without interest to note in this connection that the telephone allows an immediate contact action, without distance considerations.

Such an approach would propably enable us to see a completely different space from that which we still imagine. Such an analysis would probably reveal a discontinuous space, consisting of a series of districts in communication with each other by modern techniques. It is not impossible that the conclusions to be drawn from the analyses will reveal a certain destructuring of the old levels of communications and perhaps a "short-circuiting" of communication relays. What consequences are to be expected as far as the urban hierarchy is concerned?

Impact of Telecommunications on the Localisation of Activities

When we speak of space organization, telecommunications, regional planning, and national development, we cannot help thinking that telecommunications are bound to play an imprtant part. We should however ask ourselves on the one hand, whether such an influence really exists, and on the other what is the direction of the relationship between telecommunications and space. Is it, in fact, the introduction of communication-technology which has an influence on the organization of sapce or, is it the previous organization which determines the distribution of equipment in the territory? The existence of planning divisions in the organization of space says much about the undeniable and particularly decisive role played by the distribution of activities and classes of consumers in the country under consideration (nations or markets prospected by a firm). These planning divisions are given the task of following demand and of evaluating the future needs for extending the systems. It is thus probable that the question is dialectic and it would be in vain

to favour any direction or other in the interaction between telecommunications and the organization of space.

It is obvious, for those responsible for national development, that a necessary condition for the most satisfactory distribution of activities over the national territory consists of favouring maximum access to the telecommunication systems. The disparities in equipment and consumption are then liable to diminish as a result. However, it would be wrong to believe in the great structuring power of telecommunications. Thus, in the extreme case, the only result of "wiring" a desert would be a wasted investment (human desert, of course, without considering climate).

What was done with the telephone system is historically the major attempt to disseminate telecommunication techniques to a large number of subscribers and to facilitate the proper flow of communication in the system. The objective, as far as the economy is concerned, was of course to provide companies with a reliable service upon which they could completely depend. As far as national development is concerned, the existence of a good telephone system made it possible to avoid further pitfalls upon which attempts for the decentralization of industry and services might fail.

But the activity in the field of telephone systems is far from being the only one. It would, on the contrary, be considered as the first step, laying the foundations for provision of new telecommunication products and services in towns and regions. Thus, making use of the same network, other types of telecommunications are made possible: the facsimile, telephone conference, and even low speed data transmission (domestic or residential compunications) may be connected to a simple telephone "socket". Analogue (the human voice) or digital (binary) signals are transmitted by the same circuits and the same switching centres as simple conversations between subscribers. In the same way, the teletex, makes it possible for any body to send and receive typed messages from a special terminal connected to the telephone network.

It will be seen that the new services, mentioned here as an illustration, can provide firms with new facilities enabling them to increase their range of activities. Although the domestic market is sought after for the manufacturing opportunities presented by mass-production, it is certainly the industrial market which will see the most rapid spread of these innovations. The spread of these innovations, which would be made possible by a serious attempt to distribute them throughout the nation, implies a certain vision of national planning: the creation of a potential for development.

We might, however, ask whether such an attempt is feasible. Is the dissemination of an infrastructure sufficient for the distribution of activities in the national space? It is indeed necessary at the least. But the problem is far greater, involving many other factors. Among these factors, do we not have to include the wishes of company directors and also the policy of financial or industrial groups? Still more fundamentally, the international economic situation may have very clear repercussions on these activities and, therefore, on the whole policy of national development.

Without going to such extremes we must certainly admit that the present

development of telecommunication networks has not led to a massive decentralization of the upper tertiary sector of industry and the administration (at least up to now). It is true that this is not a simple matter, and it is not enough to provide telecommunication facilities to induce a company director the whole staff and the suppliers, to leave their original location. Considering only the company director's point of view, we are forced to admit that very often decentralization involves a geographical separation from the firm's clients.

In spite of these reservations, the establishment of an infrastructure still outlines a policy of space development (and this is particularly true in the case of the telecommunications infrastructure). Nethertheless, such an establishment could not replace the policy of space development.

Some lines of research

In order to try and clarify all the questions and considerations mentioned above, we shall now discuss some lines of research. We may ask whether telecommunications can make a contribution to reducing regional inequalities and to creating jobs in the provinces. We must, in fact, show that telecommunication networks have got a certain geographical impact and show that there is a "structuring" (and therefore "re-structuring") effect on geographical space. We have to undertake the methodological demonstration of the validity of the hypothesis. We also have to comprehend the "de-structuring" effect of telecommunications, which is probably inseparable from the "re-structuring" effect. For this purpose, we may carry out an analysis at several levels.

An analysis of the "structuring" effect presumes an in-depth understanding of the design of the networks and, in general, of the infrastructure of telecommunication media. It also implies a good understanding of concrete examples of utilization and application. It is actually necessary to carry out user surveys in the field. In this way, we can see what impacts there are in close-up At the present stage of research on the question of the relationship between national development and telecommunications, it seems to us that the most fruitful method is the systematic investigation of concrete cases: i.e. firms, establishments, administrations, etc. Thus, if there are socio-economic impacts of telecommunications, such quasi-monographic studies will reveal them in full detail. In a second step, we shall begin putting the information collected together, and thus, we shall begin the synthesis.

A whole series of questions which might confront the planner could be answered by means of this systematic investigation of concrete cases. Specific studies on the decentralization (already carried out) in the administrative sector, as well as in banks, financial organizations, insurance and industrial firms, and so on, will show what was the role -and the nature of the role- played by telecommunications in each decentralization operation. Whereas in some cases we might find a fair amount of indifference, others might prove to be dependent on telecommunications. Furthermore, in this series of analytical studies we might be able to define some types of establishments which could be decentralized thanks to the use of good telecommunication equipment.

At a second level of analysis, we should study the complexity and diversity of

the interactions between telecommunication and social and economic development. The field of observation must be chosen as judiciously as possible so as to avoid being submerged by a multitude of heterogeneous statistics which are difficult to use. "Relatively simple" economic spaces, i.e. with a relatively low density economic tissue, could be chosen for ease of observation. For example, in some countries of the Third World the difficulties in telephone and telex links may have direct consequences on the creation of job opportunities. Some firms, because of the weaknesses in this type of infrastructure, may find it impossible to create the establishments envisaged, or to increase the production capacity of existing establishments. Although we can get an abstract idea of the obvious handicap which results, it is not so easy to quantify the indirect advantages of investing in telecommunications in the industrialized countries. This must be more difficult as the number of interactions becomes greater.

Telecommunications and Urbanization

The phenomenon of urbanization may feel the effects of telecommunications. There are various approaches which are worth following up simultaneously. We might consider telecommunications as an integral part of *the urban communication system* . In other words, this means transport of people and material, carriage of information by methods involving movement of a support (paper, magnetic tapes, etc.) and telecommunications. We should also further examine the question, at the urban and inter-urban level, of *transportation and telecommunications* question. What are the inter-relationships? What are the substitution possibilities? Can telecommunication take the place of transportation and to what extent? We should also study the consequences of the use of telecommunication media on *urban organization* and the ways in which it develops. Analyses could be carried out on the influence of the telephone, and the stages in its dissemination, on urban spread and on the possibility of providing liaisons between outlying districts and the central services. In this connection, we may refer to the work of Moyer (1977), who studied the urban growth of Boston in relation to the growth of the metropolitan telephone service. This was done by examining the structure and changes in types of subscribers, and the frequenceis of use according to telephone exchange areas. Gottmann made a remark which is still completely true today: "the role of telephone in the evolution of the urban way of life has been considerable and may still be increasing. Nevertheless, a search of the libraries reveals amazingly little scholarly analysis of these issues" (Gottmann, 1977).

There are two contradictory theories concerning the interpretation of the role played by the telephone in urban organization. The first suggests that the telephone encourages and assists the formation of the megalopolis. The second, for its part, maintains that the telephone favours the geographical dispersion of places of work and habitation, and that this trend will continue until places of work are completely scattered and cities are dissolved. Such a view cannot fail to evoke, in part, the situation described by Asimov in one of his science-fiction novels. Thus, in opposition to the theory that Gottmann calls "promegalopolitan" there is another that he calls "antipolitan" (Gottmann, 1977) which even denies a need for the traditional urban centre: i.e. the "polis"

of Greek origin... . These views are interesting and deserve to be illuminated by a systematic analysis. Are the two theories contradictory? Are they reconciliable?

As we can easily imagine, the problems of work at distance are of interest in this investigation of the role of telecommunications in urban organization. Work over a distance, which is already familiar to each and every one of us through the medium of the telephone (and we may note that it is children who have most easily profitted from this use of the telephone for their homework) will probably see its field of action enlarged thanks to the new techniques: i.e. teleconference allowing meetings with managers present in distant offices (in the same town, but also in different regions or countries); electronic office; teleprocessing from the residence and so on. In part this question is one with the question of telecommunications/ transportation trade-off. These problems of work at distance go far beyond the urban level. It is the whole question of the international division of the work which may possibly know an important new moment with devices allowing work at distance.

Emergence of a New Relational World Space

As we mentioned above, the planet seems to have shrunk astonishingly. The very rapid technological development (which the geographer, the economist, urbanist or sociologist cannot afford to ignore), just as its introduction into economic and social life through the dissemination of new products and services, led us to ask ourselves what was the impact of innovations in telecommunications and of distributed data-processing on the spatial organization of industry and services on the international scale.

This is a field of research which is growing in importance. What are — or could be — the direct and indirect effects of technological innovations once they are incorporated into the normal relations between companies — the very big firms in particular? What would be their manifestations at the international organization level and on the spatial structure of industrial activities? Still further, we may ask what is the contribution of telecommunications and data technology in the operation of the international economic system and in the management of a post-industrial economy?

In the very first place, a spatial approach to the larger firms in relation to their informations flows is required. A series of monographs could then be of great use. In particular, it would be useful to study the joint effects of the use of data bases and teleprocessing networks on the relationships between production and marketing, the introduction of a world business policy, and the growth in the competence of firms for assistance and maintenance on an international level.

The impacts of the electronization of communication on the internal running of large firms must also be at the centre of the analysis. What are the direct and indirect effects of innovations in the field of electronics, data-processing and telecommunications on the internal organization of multi-national firms, on the cohesion of activities carried out on the international scale, on the decentralization of establishments, on employment and on decision-making

processes? (Bakis, 1980b).

As we can see, various subjects mentioned in the preceding discussion come up naturally when discussing the present subject. This is because the analysis of the emergence of a new world space is in a way a synthetic analysis. Telecommunications appear as the means by which the western economy in particular is achieving a restructuration having repercussions at all levels.

We may also ask what are the modifications that the effects induced by telecommunications will produce in the way that firms comprehend geographical space? Is not the emergence of a new relational world space inevitable (and does it not exist already to a large extent) due to modifications which are fundamental in more than one way in the running of the big industrial groups? Will not redistribution of the sites chosen prior to these relational modifications take place sooner or later? Will not the international division of labor (in the group and in the world industrial system) suffer some repercussions from the technological innovations in the field of telecommunications and, still more, from those in micro-electronics, data processing, robots and automatism ?

CONCLUSIONS

As we have seen, telecommunications are revealing phenomena which are of the greatest interest to the geographer, town planner or regional economist. Regional differences, daily relations,hierarchy of spaces and sub-spaces, and urban centrality, are all questions which find an answer or an illustration by the examination of some aspect of telecommunications: e.g. study of the diffusion of the equipments, study of the architectures and differential possibilities of networks, analysis of flows, etc.

Even more, telecommunications give us a glimpse of how geographical space will be utilized tomorrow, or at least of one way in which geographical space might be used. What geographical and also social, psychological, economic or political consequencial effects will these techniques have? Without going into the realm of science fiction, we have nevertheless picked out some lines of research which will enable us to formulate some answers.

Will the new town planning (if there will be one despite the impending economic crisis) put telecommunications in the organization of the city? Will relational and economic life on the planet become more and more global, as the operation of some big multinational firms would suggest? Will the constraints which localize activities (and all of our jobs) be modified by the advent of an "indifferentiated" space? If we feel the last question deserves a negative answer, we are still bound to provide arguments and show the joint interplay of contradictory factors. A whole series of questions could be asked about the future of the utilization of geographical space and telecommunications.

At a time when economic growth is slowing down and when, as a result, we may doubt the medium and long-term efficiency of "heavy" regional planning policies, the geographical impact of telecommunications and data transmission could well be that brought about — perhaps without any big planning or formalization, but not without effect — by enlightened users trying

to improve the quality of their daily, professional or cultural life.

Although some research is being carried out on the development of telecommunications and on their impact at the local and regional levels, the analysis of the phenomenon at the international level remains limited. A study of several firms would enable us to get a better grasp of the phenomenon through knowledge of specific cases.

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