



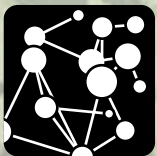
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Jean Reynaud: Seer of Space

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CASA

Jean Reynaud: Seer of Space

a translation and postscript
by
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of

One century before Christaller...a central place theory by Marie-Claire ROBIC

Introduction to the translation

In this paper we seek to present both a translation of the Robic text and a wider view of Jean Reynaud and the times in which he lived. An English translation already exists (Robic 1993) with which this paper may be compared and which we seek to improve and extend with a postscript drawing from English and French sources on Reynaud. Although the acknowledgement of Reynaud in the history of urbanism has spread relatively widely in France thanks to the work of M.-C. Robic, her work (and his) deserve a wider appreciation, in order to diffuse the nature of Reynaud's achievements more widely amongst Anglophone audiences.

C.C. & R.M.

One century before Christaller...a central place theory

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Abstract

— This article is a brief introduction to a text, unknown until now, which contains one of the first formulations of central place theory. It was published in 1841 by a Frenchman, J. Reynaud.

It is wrong to attribute the first formulation of central place theory solely to J.G. Kohl (1841) or L. Lalanne (1863 and 1875)¹ in the nineteenth century: one of the richest expositions on this subject was published in 1841 by a Frenchman, in an encyclopedia article on cities. J. Reynaud (1841) developed a remarkably modern theory for the expression of and the approach to, both the “general system of cities” and intra-urban structure² within a strongly dynamic perspective. This theory of cities includes an economic explanation and a sociological explanation of the characteristics of agglomeration, a statement of the *arithmetical laws* governing population masses and distances, and a study of the *laws of spatial equilibrium* governing the location of the centres and the disposition and configuration of their potential surfaces.

I. THEORETICAL AND REAL GEOGRAPHY

A hypothetico-deductive reflection serving policy.

For both the city as a "system" or for the "system of cities" the author uses the same method. He first establishes a static theoretical model by formalising the principles of aggregation/dispersal of the population and by specifying their spatial implications *given the assumption of a homogenous space*: this is the definition of his 'theoretical geography'. Empirical verification is then proposed, using past data,

¹ W. Christaller (1933 and 1938) cites and criticizes J. G. Kohl; R. Maunier (1910) also cites him; none of them mention L. Lalanne. The latter is, to my knowledge, mentioned only by K.S.O. Beavon (1977), who knows him from J. A. Dawson (1969), and by P. and G. Pinchemel (1981). P. Claval (1968) cites, for the 19th century, only J. G. Kohl and less theoretical authors like A. de Foville, A. Coste, E. Levasseur...

² We will not talk about this aspect here. J. Reynaud would deserve to be listed among the pre-urbanists mentioned by F. Choay (1965).

contemporary examples or statistical testing – for instance, the calculation of the distance between centres³. The model is then compared to the "real geography", which reveals, through its deviations from the rule, the secondary factors determining localisation, form and size*.

This is how the “geographical system of agricultural aggregations” can be explained (p. 671):

The first principle of the aggregation of houses is that of sociability. Most houses existing on land are placed in groups by virtue of this divine sentiment only. Without the principle of sociability rural houses would be scattered in isolation across the countryside; (because) if they took only economy into consideration, each farmer would establish their home in the centre of the fields which he cultivated. Thus lived the Teutons. Their homes were built separately according to taste. "Each", says Tacitus, "surrounding his home with space": *domum spatio circumdat*. So by giving up some of their ease of work we find that everywhere that sociability has influence, farmers group together in villages: they locate closer to each other hence moving further away from their work and consequently increasing their transport costs; so it would be easy to calculate what it costs each year, for them to live in proximity.

It is these costs that determine the size of the villages. The land beyond a certain limit may still attract its farmers: they cannot live in the nearby village without the inconvenience of daily trip costs; they are thus persuaded to build their houses in another group or village. On such a basis we may argue that the number of inhabitants in each village is proportional to the radius of the area of accessible cultivated land. It also follows that in considering a uniform extent of homogenous agricultural land the surface must be partitioned by a regular system of hexagons of cultivated land which have at their centre the village in which live the farmers.

Although it is apparent that in many places the distance between villages is roughly constant, the actual geography is not as simple as this theoretical geography. As farmers give away easy access to their land to be near each other so they also consent to locate in eccentric village sites which provide other physical advantages. Easy access to water from springs, streams or shallow wells is one of the locational advantages which exert the most powerful attraction. Whatever the demands of culture or sociability, villages are not sited without easy access to water, which is balanced by the inconvenience of transporting the ploughing instruments to the fields. It follows therefore, that the settlement pattern is determined by both the accessibility to the fields and the pattern of surface and groundwater. There are other forces that also come into play such as the pleasantness and healthy character of the sites which, although important, are often neglected; however, these effects are generally too small to require being taken into account.

Secondly, the author considers the dynamics of the settlement pattern by considering the forces of change and innovation which can affect it, touching upon

³ L. Lalanne (1863) established the tendency towards equidistance between the administrative centres of the same level in France.

* Citations from the original text by Reynaud are in small characters thereafter.

the primary principles already set out and upon the secondary agglomeration factors. For the villages it is stability which dominates (although they multiply and grow closer together, as the prosperity of the towns increases) (p. 671):

In short, as the position of the villages is determined by the physical state of the land so they have the same permanence; so that these aggregations, despite their puny construction, often have more permanence than cities since the principles of their establishment are little subject to change, and there is little chance of their dissipation, unless the country depopulates.

All in all, the author vigorously defends the value of a scientific approach that can anticipate change and so facilitate the preparation of men and things. Thus he writes in relation to urban planning (p. 683):

The usefulness of a general theory should not be doubted, even if this theory does not support positive achievement; should it result in no effect other than to show cities their imperfections and how easy it would be to address cheaply their most critical flaws, this would be deserving of esteem. Sometimes I have even thought it would be a good subject of study for architects to propose, not, as did Ammannati, the design of a purely imaginary city, but to design new cities to substitute for the old, according to the rules of the art, starting from the same location, the same population, the same customs, the same degree of wealth and the same general needs; and this approach, so varied in its universality, is even capable of providing multiple solutions for each city, by retaining from the old buildings that which the new city can accommodate without too much discomfort. Besides the advantage of such work at inculcating in the architects sound philosophical habits on a grand scale and at educating them in how to deal with cities, the populations themselves would be excited by the insights thus gained and engage more strongly in the development of their cities than they can in their present state of ignorance and consequently, of indifference. All this whilst living longer breathing cleaner air, with the view of an architecture capable of exercising a beneficent influence on them, would make it even easier, through further study of the economics principles of their cities to plan better for future change: less conditioned by the past they would be in better condition for the future

II. THE SYSTEM OF CITIES

From the general principles of housing aggregation...

The spatial implications of three general principles lead the author to conclude that there is a theoretical organization of territory based on a hierarchy of three to four levels of centres radiating out of the nested hexagons in which they are situated. The foundation of this system is the distribution of the population engaged in agriculture.

These three principles go beyond sole reliance on *homo economicus*. The first factor, psychosociological in nature, is *sociability*, a centripetal force tending to cluster the

population. This principle is reinforced or counteracted by an *economic factor*, the spatial action of which differs according to the function considered. Thus agriculture would lead to a dispersion (cf. *supra*); craftsmen, who do not need space and are prone to cluster – for an unstated reason equivalent to economies of agglomeration – disperse more than they would naturally, to match the spatial distribution of their agricultural clients (and providers); but it is necessary to distinguish between the functions performed by craftsmen and traders, according to the frequency of the requested service, and according to the customer type, rural or strictly urban, as these are the distinctions responsible for the settlement hierarchy. In all these cases the difficulty of communication limits the reach of managerial influence. Finally, the *principle of administration* adapts to the settlement pattern and confirms it, because it corresponds to a hierarchical management structure which itself is adapted *ex-post* to the distribution of the urban and rural populations (pp. 672-674):

The artisans are likely to have their homes close together not only because of the pleasure they take in their company, but also by their continuing need for each other. As the wealth they produce, unlike agricultural wealth, usually needs little space, so the land claimed by their work barely exceeds that which is necessary for their homes. We can compare them to farmers on sufficiently fertile ground that their villages have an infinitely small radius of cultivation, that is to say that every village would be contiguous. And this would indeed be their condition for, if they were freed from the need for food, or lived on fresh air alone, they would be independent of any connection with the fruits of the earth. But since they are obliged to live off the produce of the land, they must be in a position to secure such produce as easily as possible and to remit payment to the farmers with similar facility. From this reciprocity comes the requirement that the houses of both groups are in reach of each other. Hence, according to the same laws according to which all the homes serving the agriculture of a specified area locate in one village, so all the houses needed to serve a number of villages form themselves into one group. Furthermore, as the proportion of the rural population to the industrial population it can feed, is, over a large part of the earth, approximately equal to one, it follows that the artisan groups are larger than the other groups; these groups of artisans are quite likely, in areas where agriculture and industry are flourishing, to reach a population size equivalent to the sum of all the populations in the villages they serve. Thus more powerful aggregations called cities develop at the centre of rural aggregations and under their influence. It is obvious that, theoretically, in the case of a homogenous area, their geometric position relative to the villages is exactly the same as that of the villages relative to the fields; that is to say that, given a rural territory divided into hexagons, using new hexagons which cover a previously determined number of the rural hexagons we would assign cities to the centre of the new hexagons. It is also clear that the size of these hexagons is determined by consideration of the convenient communication distance with respect to the relations that must exist between the cities and villages. So cities are governed in their size and position, by the state of communications and cultivation in the country, and they cannot depart without damage, to country or themselves, from the laws imposed on them by these conditions.

It should be noted however, that we have oversimplified the problem. We have, in effect, treated artisans of all kinds as being in the same condition, in relation to the need they feel to be with each other and with respect to the trade that is established between them and the rural population. This assumption is not accurate; because while there are artisans whose work is continuously needed by farmers and must be retained among them, there are others that are barely necessary to farmers or with whom they need only maintain distant relationships, and finally there are whose work, intended only for cities, is alien to the countryside. These artisans instead of being distributed equally between all cities, tend to gather in, and thereby alter in character and size, those cities that are in a more suitable position than others. Thus we see how, from the villages, the various aggregations graduate naturally following a hierarchy that can be reduced to approximately three or four levels up to the nation's capital aggregation. Note that what was said of artisans applies strictly, and to the same extent, to merchants of all kinds, since there are merchants specific to the countryside, others to the various cities, and some to the capital. The natural distinction of the cities is thus further corroborated by this principle. And we must also consider that those industries and businesses that are the most sophisticated, being also the most complicated and the most productive, are those which attract the most people to provide support services to their workers' activity and persona; thus the more economically successful the city the more it attracts not just elite but also subordinate workers.

The public administration, through the distribution of its officers in all parts of the county and through the meeting of the different orders/institutions/groups it fosters in cities, establishes the third general principle of the aggregation of dwellings. It accords with the other two principles, especially with the second of which it is only the accompaniment. As the groups to which it gives rise link themselves by more or less pressing functions with the people of the countryside, it is clear that the places that are suitable for such groups are in general the same as those that suit the artisans and traders. The correspondence is further ensured by the fact that administrators, being needed by urban as well as rural populations, would have incentives to settle in cities to serve the urban population, even if they were not already attracted there by the rural population, because of the convenient location of cities with respect to village locations. The villages determine the cities' locations which, combined with the villages' locations determine the location of the administrators. However there is no reason to conclude that the circular areas which are the responsibility of each central administration should always be identical with those of the industrial and commercial influence of each city. There is nothing more normal than that these various areas of influence are determined up to a point, by non-agricultural considerations. It is the mode of government of each country which determines these inequalities, and they can not avoid their share of responsibility. However, experience suggests that in principle, administrative centres tend to be subordinated to each other following the same hierarchy as the unconstrained local aggregations; so that the overall effect of government is to confirm, by the location of its establishments, the original classification of cities.

This classification is confirmed by a perfect fusion of the third principle with the other two principles on which the classification depends. Indeed, for sociability, it is clear that officials must necessarily, with the resources or the

power which they are endowed, exert a particular attraction on others; and as with trade and industry, the tastes and income of these same people must ensure a need for refinement that attracts a special group of people around them. The administration cannot determine the cities alone, but constrained by their actual location, cities may still grow or decrease in a significant proportion according to whether they are the locations of administrative agents or not. Furthermore one can specify this influence by a geometric law, which, without being taken literally, at least gives the thing a marked character: it is that population growth, determined by the existence of the administration and of the various associations, is in proportion to the square of the population located in their catchment area; this results from the number of officials being roughly proportional to the size of the population they administer, and so too their importance as measured by the number of subordinates that attach to them.

... to the influence of geographical inequalities on cities

To summarize, these are the laws which would determine the distribution of housing in a homogeneous and united world. Although it is easy, within this theory, to develop the analysis much further, these general indications of the action of the fundamental principles seem to be sufficient. The theory, however, assumes a uniform territory, therefore it is essential to correct the previous results by looking at anomalies in the location and size of cities caused by surface inequalities.

The "surface inequalities" invoked, both natural and human, are primarily due to the *heterogeneity* and *anisotropy* of the territories.

The author first examines the effects of differences in fertility and in agricultural practices. Following a complex argument, he concludes: "... the towns are indeed not only smaller, but fewer in the poorer territories as compared to the more fertile" (p. 674).

J. Reynaud especially emphasizes the uniqueness of the location of the industrial cities, which, being determined by the irregular distribution of deposits, represent a considerable source of "anomalies" at variance with the "regular laws of geography". He discusses at length the *specific logic* of industrial locations, evaluating their dependence on the singular points of deposits of raw material, according to its value, the cost of its transport and its importance in the final product. He also notes the particular characteristics of *specialised* industrial centres and the growing disparities between regions caused by the uneven distribution of energy sources (p. 674):

Differences in agricultural wealth are not the only factors to consider. Those such as mineral wealth often have an equivalent influence, and their geographical features are always more distinct. While agricultural products are harvested everywhere in the inhabited world without variation other than in abundance

and quality, there are only some districts, which are generally small, from which essential minerals can be extracted. This geological law therefore determines the locations of some singular points. The uniqueness of these points is all the more important for political geography, if the raw material concerned is of lesser value but accounts for a larger proportion of the final product's cost. It is easy to see why. In effect, if this material has great value it can be transported a distance proportionate to this value without being significantly affected by the cost of transport; so all the points in a district of a given extent are roughly comparable in this respect. If it has a low value, but contributes only as a small share of other products consumed concurrently, the transportation cost tends to disappear in the total, so that there is a district of a certain size within which industries based on a minor use of this resource can settle anywhere. But if, by contrast, the raw material has a low value and the industrial production processes use it in major proportions, then it is impossible to consume it without disadvantage anywhere apart from where Nature deposited it. This place is where the resource-based industries have to cluster. These more or less numerous aggregations, determined by this cause alone, are therefore independent of and often contrary to the ordinary rules of location. Thus one sometimes encounters cities based on the mining of metallic ores, where all the inhabitants have the same occupation and which, with the size of a large city, have the character of a small, and which may arise in sterile countryside which, without the ore, would hardly support a village. But it is mainly at those places where the land contains fuel that these anomalies become excessive. Indeed, it is no longer, as in the case of metal ores, a particular industry but rather, a collection of different industries, each with similar needs, which seek the same location. Hence the conglomerations of workers housing and manufacturing of all kinds in those places so endowed, following the rise of the technology on which they are based, are located contrary to the regular laws of geography. Cheap production of iron, when the ore is in reach, or the cheap production of heat and power, becomes their fundamental principle, and cheap agricultural production so compelling elsewhere, here becomes secondary. Nowadays the forces of iron, heat, and machinery, tend to occupy a more and more important role in societies, so increasing inequalities in the general system of cities appear either between the territories of various nations or between the various parts of these territories, depending on whether the fuel deposits there are scattered or concentrated in a small number of points. Stronger inequalities necessarily manifest themselves from one territory to another more significantly when the underground deposits are the sole source of these three processing elements, rather than the coal, heat, and the dynamic power being concurrently provided by surface resources, that is to say by timber and by water power.

The anisotropy of space due to transport routes is also a major cause of deviation from the model: the *attractive force* "proportional to the difference in the ease and value of communications" modifies "at least within limits" the hexagonal geometry derived from the "laws of the countryside" (p. 675). The author refers to the canals and rivers, railways and roads linking major cities. In the latter case, besides the ordinary anisotropy introduced by any valued network, the author adopts a *transport principle* which advocates as a *standard* or an *objective of organisation*, the existence of more convenient and more direct links between the main settlements (cf. in the same

article, he makes a plea for a hierarchical intra-urban street plan, directly connecting the major centres of the city.) (Reynaud, 1841 b) (p. 674-675):

The differences in the ease of communication are an inequality of another kind, which it is even more important to take into account. It is obvious, that since the ability to transport themselves and their goods from one point to another is no less important to their common interests than to draw from the earth the substances they need, men should be induced to establish their residence in those places where they enjoy the highest level of this facility. Hence it follows that the routes that connect major cities with capitals, on which traffic generally moves more freely than elsewhere, naturally tend to attract to those cities with which they have no particular connection and which, without this attraction and governed by the laws of the countryside, would be situated to a greater or lesser distance, to one side or the other of the main routes. It is also evident that the intensity of this force of appeal must be proportional to the difference in the ease and value of communications between this route and the surrounding roads. This is why we cannot avoid considering the railways since, from our point of view, they give incomparable superiority to all locations within their neighbourhood, and consequently tend to denude, at least within certain limits, the intermediate gaps between cities, and thus become essential determinants of the geography of cities. We must recognize that these railways also tend to decrease the interval between, and consequently the number of, cities. However it should be noted that this effect can never extend as far as it surely would if the position of the cities, instead of being determined to some extent by the requirements of the countryside, were determined only through the relationships between the various cities. Finally, it is equally understood that the canals and rivers, with their unique capacities for transport, also enjoy, in a magnitude of their own, a similar force of attraction. As the water courses needed for irrigation and other uses of the countryside are the primary cause of most of the variations in the distribution of villages, so the navigational routes crossing the territories are the most frequent cause of variation in city location.

Analysis of the distortions in the model is completed finally, by taking into account two new factors in the study: warfare and the holiday trade. The first encourages both the displacement of settlements towards defensive sites and the establishment of military towns in strategic locations. The second determines the origin of those specific cities with the requisite locational standards (p. 676):

I mean the places favoured by a gentle climate, magnificent views, charming walks, and seemingly formed here and there throughout the territories to provide pleasure gardens, where during the summer those who need relaxation and recreation can enjoy the pleasures of the smartest society together with the most agreeable countryside.

An open system.

What is described is a whole system, a general system of interdependent cities: the capital of which is a privileged expression, a resultant of all the *forces of gravity* and all the *real values* of masses and distances (p. 676):

In summary, there is no inequality of any importance that does not enjoy the property of producing a particular action on cities. Hence it follows that the general system of cities can be seen as offering, up to a point, a representation of the general system of territorial inequalities. But there is one representation even more condensed, although in truth less direct and less explicit: it is the capital. Indeed, this aggregation dependent, according to a defined order of relations, on all the territorial aggregations, necessarily reflects all their abnormalities. The calculation of its position is therefore the most composite, since it not only combines the calculation of the state of all other cities, but these cities themselves, by coordinating/interacting, produce a new complication. The composition is such that it can only lead to approximations as to where the convenient location of the capital might lay. However, by pure political arithmetic, considering only the expression of regular relationships between the capital cities and their surrounding territory, one can say that the calculation of their position is identical to the problem of calculating centres of gravity. One can, in fact, see the capital as a point simultaneously attracted to all points of the territory, by a force proportionate to the importance, or, if you will, the political weight of each of them, and therefore held in equilibrium in the central position that balances all these particular forces. So if the population was evenly distributed throughout the territory, the capital would be located symmetrically at the centre of gravity of the territory. But as this uniformity is never found, it follows that the capital is forced by circumstance, away from this symmetrical position; so that even assuming a circular territory, there would be seen a certain eccentricity resulting from the uneven population density. It should be noted that uneven density is not the only factor causing variation; because at numerical parity, populations from one point or another still differ in the weight that should be attributed to the people who comprise them. This is what makes the capitals, in addition to their general propensity to locate in parts of the territory where agriculture is the most developed and the population is proportionally the largest, suffer an even stronger pull towards the favoured centres of trade and industry. In summary, there is no doubt that the position of capitals, however difficult it is, remains a matter of calculation, because it is not dependent on any single condition that is cannot be mathematically defined. But we must be careful to note that the elements of this calculation are not simply translated on the field because distance in political geography, is not measured by compass, but by the ease of transport. Hence it follows that the capitals are often closer to distant points than to geometrically neighbouring points which are connected by less convenient transport. And it also follows that the variations in the position of the capitals, which are controlled by the changes in the internal condition of nations, do not always require that such cities are actually moved.

Moreover this system is not closed: the nature and weight of external relations also have a bearing on the gravitational model that defines the location of cities.

On change.....

“Cities are never what they were the day before or what they will be tomorrow” (p. 684).

The continuing change in cities is their growth, caused by the dialectical effect of the prosperity they occasion around them which diffuses depending on distance, and is self-sustaining. Since the initial inequalities increase in the same proportions, growth is accompanied by an overall inertia in the spatial system (p. 684):

If we consider things in their steady state, the only change in the cities is growth. Once established in a position reflecting the interests of the surrounding rural settlements, far from having a tendency to relocate, they take root more firmly. It is easy to see why; for barely formed, they are for villages a source of prosperity in which they can participate more the closer they are, they encourage farmers to group together preferably near to them, to open up communications on all sides of the town and finally they systematically coordinate the district over which they preside. So that after being created at the convenience of, and by the wishes of the villages, they respond to the villages which are forced to organise around them. It works in the same way as in animal development when, after an initial simplicity, the heart is created and immediately connects to neighbouring parts and to the organs that created it when seeking a centre and, while developing them, the heart also develops itself in response to their influence. The rural populations multiply because of the advantages bestowed by the city, and becoming both more numerous and richer, they ask more work of the city, which consequently gives rise to more population and housing. Thus, day by day, the town grows, and its effects on the countryside are marked more widely; finally, in a manner of speaking it becomes part of it: imagine its walls drowning during the night in the abyss, its place would be found the next day by examining the roads, the concentric pattern of the villages and the practice of the rural populations in the fields to orient themselves towards it, as if to their common good.

Thus capitals are like a mass around which nations condense concentrically and which gives political geography a more stable equilibrium. Although this geography, by increasing the number of people, is in continuous but proportionate change, like any system change of state, the pattern of the framework remains constant. In truth, the cities, by a law that we have already noted, tend, beyond a certain time to multiply instead of developing on their own; but looking at the multiple dissemination of neighborhoods of the same city into the country, is in fact no different. Ultimately, despite density variations, the general gravitational pattern of the country remains the same, and the central point of equilibrium does not change.

In fact this uniform growth rule is invalidated by the observation of differentiated rates resulting from the multiple hazards that actually affect the development of cities: J. Reynaud reconsiders the principles of agglomeration from the standpoint of innovation (technological change, new trade routes, destruction, territorial

changes, effects of uneven growth, grouped in a set...). He finally finds a stochastic growth law, by which the multiplicity of causes of variation and the large number of affected cities lead to a fundamental inertia of the system despite the perpetual instability of its components (Pumain, 1982) (p. 685-686):

But in reality, change does not take place in cities according to a simple plan. Far from preserving consistency among themselves, they vary markedly from each other, each in its way growing or decreasing at varying rates. It therefore happens that their overall system, as a result of these particular changes, takes on another symmetry with the consequence that it tends to create another capital. It is important to briefly touch on these things (...).

To recap, from a multitude of causes the last of which are lost in a never ending analysis, the cities are in a condition of perpetual instability. The geographic distribution of population is unstable as a whole. In their position in the large territories we see populations which, similar to a disturbed crowd, concentrate at certain points and then disperse repeatedly in an endless movement. So their political centres, far from enjoying stability, suffer a continuous oscillation. In truth, the cities are numerous, so there is a tendency for their variations to cancel each other out, meaning that the centre is less affected by the total sum of changes that each city individually experiences.

Finally, J. Reynaud attempts to predict the probability of relocation of the European capitals under various assumptions. For example, Paris would remain fairly stable: "In effect, through a harmony worth noting, while France, by virtue of a likely growth in interests, is animated by a virtual tendency towards the south, the only increase in territory that can reasonably be expected and desired, pushes France in the other direction. (...). In this new geography of France, the current territorial eccentricity of Paris is thus corrected" (p. 687).

The article ends with a hymn of praise to France and to Paris.

"In other words, there is already no more than one city in France, and this city is France itself" (p. 687).

III. WHO WAS JEAN REYNAUD?

J. Reynaud (1806-1863) belongs to that generation of Polytechnicians who graduated in the 1820s and were affected by Saint-Simonism, and marked the nineteenth century with their thoughts and *their activities*. A graduate of the École Polytechnique and the École des Mines, J. Reynaud barely exercised his art – he returned from Corsica on learning of the Revolution of 1830 and applied for

indefinite leave – to devote himself to the work of a propagandist, of a man of letters (see the New Encyclopedia he co-directed with Pierre Leroux, 1836-1842, and for which he was one of the principal contributors), of a politician (he was Undersecretary of State in the Ministry of Education in 1848, summoned by his friend Hippolyte Carnot, a member of the Comité des Capacités; he participated in the establishment of a short lived School of Administration), finally he was also a philosopher.

Nurtured in admiration of the Encyclopedists and the revolution of 1789, a modern scholar, a mystic and an aesthete... J. Reynaud was convinced of the perfectibility of men and their freedom in relation to nature "by their progress in association and in industry" (Reynaud, 1841c, p. 437): the earth must be corrected, and organized in accordance with its laws: "We are moving towards a limit, an extreme limit, it is true, and purely ideal, in which unbothered by the physical conditions in which they were born, and having the upper hand, men will be in harmony in all respects with their world and wellbeing" (Reynaud, 1841c, p. 437).

In relation to the history of geography and spatial economics, the thought of J. Reynaud is of interest firstly because of its representation of real complexity in his many sketches of spatial laws (central places, gravitation, industrial location, economies and diseconomies of agglomeration...); secondly because it provides several combinations of explanatory factors contributing to an image of man less simplistic than in most models: socio-psychological foundations, economic constraints, principles of power (related to war and administration), hygiene (the question of public health), aesthetics and pleasure... This whole is integral to the theoretical constructions based on the idea of *totality* and *change*. The dialectic of relations between component parts and the whole, between unity and diversity, between variation and stability, infuse his discussion: the application of geographic laws evolves not to conflict but to changes in harmony with progress and organizational improvement.

A whole constellation of thinkers might have inspired Jean Reynaud (including notably Petty, Cantillon, Steuart and Vauban to the latter of whom he devoted a laudatory article – Reynaud, 1841 d). His thoughts completely ignored until now, were concerned with the organization of space and convinced by the need for state intervention. He can also be considered a milestone in the lineage of theoretical geography. This singular and unknown figure wrote at a time of a relative vacuum in French geography, which coincided, with some exceptions, with a low ebb in spatial economics (Ponsard, 1958; Dockès, 1969). This fact reinforces the

relevance of further study of the meaning of the work of J. Reynaud in the history and epistemology of geography⁴.

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⁴ This study is being realised within the framework of research on human geography in France, during which I discovered Reynaud's text.

Reynaud (J.), 1841c, «Terre», in *Encyclopédie Nouvelle*, t. VIII, p. 417-448.

Reynaud (J.) , 1841d, « Vauban », in *Encyclopédie Nouvelle*, t. VIII, p. 609-614

Postscript

In presenting a theory of urban dynamics and mechanisms which leads to a hierarchy of central places radiating over nested hexagons, J. Reynaud deserves much of the credit usually given to Christaller. Moreover, Reynaud prefigures the understanding of the different principles that govern the location of cities, with mentions of three factors, economic, administrative and transport which cause deviations from the theoretical hexagonal pattern. We do not know if Christaller or others knew of this theory although Christaller may be credited with first presenting it in an operational form. Christaller's work and Christaller were employed by the Nazis and later by the Communists and this official recognition may have secured his reputation against competing claims. However, what matters now is that Reynaud is acknowledged as the first known contributor to this family of theories which aim to explain the regularities of systems of cities (their size, spacing and specialisation).

In the framework of complex systems, it is generally agreed that single discipline accounts of urban patterns are insufficient to explain their generation and dynamics. In the field of urban economics and regional science for example, O'Sullivan [2004] or Martin [2015] call for the integration of partial theories into large scale models for the purpose of understanding and intervening in the spatial economy. Reynaud's thinking fits well with this method of research, as it describes an urban theory, which is both multilevel and multidisciplinary, and which aims at explaining both the pattern of cities location and their deviations from the model. After decades spent examining agglomeration economies [Rosenthal & Strange, 2001; Duranton & Puga, 2004], Reynaud offers a fresh reminder to the regional scientist of the non-economic incentives from which the agglomeration of people might arise. More specifically, he helps in rethinking the psycho-social advantages of density, e.g. living within a proximate society, which has more than a mere economic rationale or a univocal advantage [Schopenhauer, 1880]. Schopenhauer's hedgehogs clustered for warmth but not too close for fear of their spines. The anonymous author in Fraser's Magazine [M.B.E. 1878] suggests that Reynaud was the only French philosopher to impress Schopenhauer. Although the religio-scientific philosophy of Reynaud may be seen as a precursor of scientism and historicism [Lyon, 1961] this should no more detract from his achievements than should Newton's alchemy from his.

In considering Reynaud's contribution it is important to understand the context in which he was working and the flux of ideas around him. If we consider the following translation it shows the extent to which Reynaud's ideas were set in a religious frame of reference. The passage is in "*Terre et Ciel*" (Reynaud 1854) taken from Fraser's magazine [M.B.E., 1878] which draws upon the biography by Legouvé (1864).

“Adam did not more entirely possess the fruits of his narrow Paradise than we in the present day possess all the combined products of the seas and continents of our vast inheritance. This common enjoyment of the fruits of the earth would not be a sufficient corrective of its vast size, were it not for the ease with which, in contradistinction to our ancestors, we are enabled to transport ourselves from one place to another, and to maintain our relations with various parts of the globe. Such is the result of international commerce. So lively has become the correspondence between the various quarters of the world, that letters and travellers are perpetually crossing each other on their way. And as voyages and journeys become longer and more frequent, they also increase in speed and facility, so that the extent of the globe and its relation to man are determined, not by relative size, but by the ease with which we can reach the most distant parts; the result being that the dimensions of the world, instead of being fixed, progressively diminish from day to day. Who indeed does not perceive that, viewed by the light of geography, the earth is infinitely smaller to us than it was to our forefathers – that each year, in consequence of the improved methods of communication, it suffers further diminution, and that it is destined to become still more limited to our descendants? So far as the transmission of thought is concerned, distance no longer exists; by a miracle, before which our forerunners would have stood confounded, we shall soon be enabled to converse with the antipodes as easily as with our next-door neighbour. Thus, whilst the ancients could admire Divine power in bowing before the majesty of the earth, we should see ourselves compelled to take a very limited view of the handiworks of the Creator if we were obliged to judge of them by an abode where already we begin to find ourselves cramped for space, where the longest voyages are mere beaten tracks, and, to sum up, where already statisticians begin to tremble when they think of the little room that will be left for posterity. Happily we are more than compensated for the lost majesty of the earth by the new vistas astronomers have opened in the heavens, so that whilst the first appears narrower and narrower, the sidereal world conversely astounds us more and more by its immensity.”

This early consideration of the 'death of distance' - the first transatlantic telegraph cable was laid in 1858 but was short lived with success delayed until the mid 1860's – shows Reynaud's prescience and also his religiosity and respect for nature. This interest in the natural world, in particular in astronomy, had been encouraged from an early age by his mother. At the same time he was brought up in an intensely religious age and his work is infused with the tension between his need for a divine moral order, his scientific rationality and his deeply felt egalitarianism.

Reynaud was educated at the *Ecole Polytechnique* and subsequently the *Ecole des Mines*. In this period he learnt of Saint-Simonism from Enfantin. He went to Corsica as mining engineer in 1829 but finding little mining, mapped Corsica instead. On hearing of the 1830 revolution Reynaud rushed to Paris and linked up with Leroux. They worked together in Lyon; both advocated the responsibility of the producing classes for the labouring classes in accordance with Saint-Simon who had advocated a world run by industrialists and men of ideas on behalf of the poor. However, on their return in 1831, they found Saint-Simonism was in turmoil and they rejected it following a dispute with Enfantin on the organisation of the Saint-Simonian school, his mysticism and the place of marriage in society. Reynaud was interested in reforming the society in a rational way through State intervention - cf. "*De la nécessité d'une représentation spéciale pour les prolétaires*" (Reynaud, 1832), cited by Plekhanov, which stated the opposition of the proletariat and the bourgeoisie fifteen years before Marx and Engels [Griffiths, 1982]... Another domain in which Reynaud's contribution is considered important yet forgotten!

With growing opposition to the newly installed monarchy, they worked together on the production of Reynaud's early Saint-Simonism, a form of utilitarian socialism, Reynaud retained his rather more conventional ideals and his spiritualism. Saint-Simonism sought in science an organising principle which became identified with Newtonian gravitation [Lukes, 1967]. This principle seems to have informed Reynaud's writings on location theory. With Leroux he founded the *Encyclopédie Nouvelle* in 1833 as an attempt to map current knowledge in a form accessible to all. His work on location theory was published in the *Encyclopédie Nouvelle* of which he and Leroux were editors. In 1833 they cooperated in writing "*Exposé des principes républicains de la société des droits de l'homme et du citoyen*" [Leroux and Reynaud, 1833] in which they argued for a combination of republicanism and socialism to accomplish social reform over the needs of the individual. However,

for Leroux and Reynaud collectivism was as dangerous as extreme individualism. They sought a solution in metempsychosis or reincarnation. Reynaud expanded on this in “*Zarathustra*” an article in *Encyclopédie Nouvelle*. His recourse to theories of reincarnation to resolve this conflict reflected his deep religiosity and that of the period [Sharp, 2006] as well as a fear of moving too far and too fast from the *status quo*.

Notably, Reynaud published two articles “*Terre*” and “*Ciel*” in the encyclopaedia and it is these and the subsequent article “*Druidisme*”, on which much of his reputation at the time was based [Cuchet, 2004]. Reynaud’s writing on druids were part of the fashion of druidic revival. It became in the 1850’s and after, a basis of a new nationalism that sought to build upon the past and show how its features, equality in marriage, an emphasis on commerce and, more controversially, reincarnation, could form the basis of a new order. Although both Reynaud and Leroux supported the collective reform of society in order to aid the individual while retaining the values of the Revolution but with individualism restrained by a religious sensibility, Reynaud, more so than Leroux, emphasised the importance of the individual for whom progress was characterised by successive reincarnation with their current position being where they deserved to be. This reconciliation of justice and the existing social order might seem to justify the latter; however, Reynaud felt that individuals could improve and redeem themselves during their current life through charity and solidarity.

Both Leroux and Reynaud supported the rights of women and the democratic representation of the working class and both joined the new government following the 1848 revolution. Reynaud became Under-Secretary of State in the Ministry of Public Instruction, emphasising his commitment to education and self-improvement. However, being firm in his idealism, he did not long survive the pragmatic realities of politics and resigned after only a few months. After this brief exercise in politics, Reynaud retreated into a more mystical phase reflecting the dangers associated with socialism under the Third Republic and Second Empire of Napoleon III. His ideas were still important as evidenced by the publication of “*Terre et Ciel*” in book form in 1854 and its excoriation by the Catholic Church in 1856. The translation below taken from Fraser’s magazine [M.B.E., 1878] points up Reynaud’s dissatisfaction with the conventional views of paradise and his desire for continual improvement and progress through

reincarnation (which economic geographers nowadays might be tempted to interpret as a critique of equilibrium models):

“No more time; no more change; never more anything new; no more acts of charity displayed by one human being towards another; no more salutary reflections, no more aspirations after the Divinity; the elect in their places for ever and ever in Paradise, the damned in theirs below. The time is gone when good men can delight themselves in lifting their brethren out of evil, and in feeling that even the created world yields to their efforts and gains each day, owing to them, an added grace, an added beauty, where those who have had the misfortune to go astray are able, after their lapse, to return to virtue and follow the straight road in company of the righteous.... There is no more progress to hope for in this terrible succession of age upon age, neither for one’s-self, nor for others, nor in heaven, nor in hell, and the law of unchangeableness is henceforth the law of the universe.

... Ah! how this paradise repels me! how infinitely I prefer my life, with all its misery and tribulations, to such an immortality and such a beatitude!”

Reynaud after refusing any further political posts, died in 1863 and received a Catholic burial. At his death, Reynaud was a public figure, praised and followed by his contemporaries, respected and known for his religious philosophy. However, this part of his thinking, as recalled, criticised and opposed by Proudhon, came to contrast with his earlier social analysis (from which the Robic[1982] paper is drawn), since reincarnation and the pre-existence of souls in Reynaud's druidic philosophy suggests an *essential* inequality between men, if not a justification for their current place in society [Cuchet, 2004].

Much of Reynaud’s work is available on the web site of the Bibliothèque nationale de France in particular volume 8 of the *Encyclopédie nouvelle* [Leroux, P., & Reynaud, J. 1836-1842] in which the section on *Villes* contains much of the information on which this paper is based.

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