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The rise of demography as an autonomous science

Exposition of the Problem

From the scientific historic point of view demography as an autonomous science is one of the youngest branches of those social sciences in the modern sense which emerged from the scientific development connected with the rise of capitalism. No doubt, the interest of statesmen and philosophers in questions of population has always been present in human history since the emergence of political and State organization; but in this early stage, this interest never surpassed the rudiments of population policy, either in this domain, the demographic thinking did not exist before the 17th century. This kind of practical politics as an "art" was firmly incorporated into the body of early mercantilist thought, i.e. a mixed kind of State-science.

The caracteristic of this early period, which saw the first appearance of the elements of modern demographic thought, was the consideration of population policy tenets as a knowledge situated halfway between practical politics and political theory or political science itself, under the German denomination of "Staats-Kunst" or according to the Latin scientific term of the epoch: an "ars". The most fervent protagonists of this current of thought came mostly from the representatives of the different branches of emerging statistics, a new science itself, i.e. either from the German University Statistics or from the English Political Arithmetics.[1] These early statisticians from both branches were all further oriented also toward Political Science and especially toward its most up-to-date incarnation of modern capitalism during this take-off period, i.e. Political Economy. With this rather complicated scientific background and with the corresponding intellectual and scientific historic development only the most important sources of the future science of Demography are delineated. One should, of course, name a lot of fields and branches of other sciences or practical knowledge from which the emerging demographic science or at least some of its elements were orginating, to think only — besides Political Science, Statistics and Political Economy, of Legal Science, History, Geography or Medicine, and from the methodologic point of view, of course, Philosophy and Mathematics, to mention only the most important ones.

If one wants to give an approximately correct picture of the emergence of Demography as an autonomous science from this complex of relatively new social sciences of the early capitalist period, one is forced to choose some criteria of this scientific evolutionary process

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[1] The *Author* of the present essay dealt with these two sources of modern Demography in the following two papers: Le Développement de l'Ecole de Statistique Descriptive Allemande (Une Synthèse de l'Histoire Scientifique en Statistique), Acta Universitatis Szegediensis, Juridico et Politica, Tomus XXVIII, Fasciculus 7, Szeged, 1981, — and: Essays in the History of Political Arithmetics and Smithianism, Ibidem, Tom. XXV. Fasc. 2, Szeged, 1978.

with the help of which one may classify and evaluate the significant changes and build up a corresponding framework of periodization to locate the most important changes and fit them into a definite pattern. It is with the help of such a framework that our analysis could arrive at the final stage of development, when the evolution of Demography fulfills all the selected criteria and emerges as an autonomous science. Forunately, such criteria are already elaborated in scientific historical analysis by *Schumpeter* for the use of economics[2], and so they are well-known to us all, even if they were never consequently applied by their inventor, not to speak of other scholars, in Political Economy.

These criteria may be summarized as follows: for the emergence of a new science in the modern sense it is absolutely necessary, first, to have a new scientific object — or subject — in the specific sense that this object has not been treated yet from the special point of view in which the new science is interested. This means that the object must not be "new", only "the point of view" of the investigation, in such a manner that it should enable the development of a new aspect in the analysis of the object, adding new knowledge to the existing body of the established sciences. The second criterion is that the "new" object has to be treated with a special method, appropriate to bring to light the new aspect of the object and contribute to the efficiency of the analysis and be in harmony with the requirements of this new field of study. Let us note that in the elaboration of these two criteria, *Schumpeter* was very explicit and complemented them rather tentatively with a third one, when he spoke of the necessity of the so-called "self-identification process" of a new science. He unterstood by this term the criterion of the consciousness of the effort by scholars to create a new science. The latter should have been aware that they were creating additional or complementary knowledge surpassing the field of the established sciences by delineating its object and method and by neatly separating it from them, — and that they have to denominate this new science under a proper name not contested by any other discipline.

Curiously enough, the fourth essential criterion in this special scientific historic context was never brought up by *Schumpeter,* not even implicitly. The reason may be found — I venture to say — in fact that this problem was rather self-evident in Political Economy. I refer to the problem of final theoretical basis of the new branch of knowledge, how it could be inserted into the general philosophical or, more exactly, into the general epistemological tenets of the other extablished sciences, — either natural or social. Another scholar, notably *Julien Freund,* insisted on this problem of scientific development one decade ago[3]. He was of the opinion that the formation of the so-called social sciences in the modern sense was characterized by the creation for their own needs of an all embracing scientific theory different from that of the natural sciences as concerns the explanation of the final questions of human knowledge related to social phenomena. Or to express it differently, for the representatives of the new social sciences, the social reality became a kind of different, if parallel world existing in its own right, with its own laws even if their character was a different one. As the Hungarian philosopher *George Lukács* put it, the society as human environment may be identified as a "quasi-nature" by people born into it as naturally as into nature itself[4]. As we will see later, for demography, this fourth criterion is of crucial importance when we want to define it as an autonomous science or discipline.

[2] *Schumpeter, J. A.:* History of Economic Analysis, Edited form Manuscript by *Boody—Schumpeter, E.,* 1st. Ed. London, 1954, 6th Printing, Ibid., 1967, pp. 380, 342 and 142.

[3] *Freund, J.:* Quetelet et Auguste Comte, in Mémorial Adolphe Quetelet, No. 4, Académie Royale de Belgique, Bruxelles, 1977, pp. 46 and further.

[4] *Lukács, G.:* Geschichte und Klassenbewußtsein, Berlin 1923, p. 97, English translation under the title: History and Class-consciousness: Studies in Marxist Dialectics, Reprint, 2d Impression, London, 1971.

I have to mention in this context the emergence of a possible fifth criterion if only drawn from my own experience, which could be useful equally for this demographic scientific historic analysis. Notably, during my research in the history of statistics, inspired by the life-work and scientific activity of *Quetelet,* to understand better the formation of this new science, I have defined rather instrumentally the institutionalization of a new science as a fifth criterion. By this concept, I have tried to identify not only the creation of official statistical services in state administration as the most striking example of institutionalization, but also their deliberate and organized cooperation with the scientific community concerned, either on the national or international level[5]. The national cooperation — according to my use of this criterion — includes the formation of a high statistical council over the state statistical bureau and composed of outstanding scientists and administrative experts as provided by the statistical law of Belgium of 1846. This kind of cooperation quickly extended to the international level, in the form of international statistical congresses organized by *Quetelet* from 1853 on.

This latter step in the development of modern social sciences was a crucial one after the breakdown of the unity of the late medieval scientific community. In this earlier form, the extent and the size of the scientific community was relatively small, including the bulk of scientific knowledge; but this knowledge and its language was universal and the contacts among scholars nearly exemplary. Ensuing from the relative scarceness of science, its impact on political and social life was great and easily transmitted to these latter spheres through individual links with sovereigns or leading political personalities. The change in statistics was especially radical in this respect: the rapidly growing division of labour in the statistical bureaus quickly surpassed the manufacture-like organization and led to the adoption of industrial machinery and management on the one side and to the adoption of the more and more elaborate and more and more sophisticated statistical methodology on the other. The institutionalization became thus unavoidable already in the middle of the 19th century and "a fortiori" so in the subsequent one, as *Quetelet* had genially foreseen this trend of development.

In retrospect, there was only one major gap in his coherent conception; notably, the institutionalization of the teaching of statistics at contemporary universities was not included. So the lessons of the German university tradition, the close connection between the teaching of statistics as a "Staatskunst" and the needs of its everyday application in state-administration for uses of population, economic, and social policy purposes, — was mainly lost in the 19th century. This gap in the Queteletian conception of institutionalization of statistics became especially crucial in the 1880's, when the "era of statistical enthusiasm" abated[6] and one could find an interesting parallel from this point of view with a lag of nearly one hundred years in the history of formation of demography. For this reason, I would like to include this fifth complementary criterion in the analysis of this field.

After these introductory remarks of a rather methodological character, one further remark seems appropriate in this context: despite the well-known fact that the formation of Demography as an autonomous science is a 20th century achievement, it is essential for its comprehension to piece together its relatively rich — one is inclined to say, outspoken brilliant — heritage. Notably, by applying the above-mentioned five criteria, we may be able to find out how they contributed to the final emergence of Demography as an autonomous science. In other words, instead of trying to summarize the broad and only mono-

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[5] See in the *Author's* University Scripta: Statistics I: General Statistics, For the Use of all Faculties of Political Sciences and Law, State University Publishers, Budapest, 1967, Chapter I: The History of Statistics, pp. 3. and further (Hungarian text).

[6] The expression comes from *Westergaard, H.:* Contributions to the History of Statistics, London, 1932.

graphically treatable historic process of the formation of this new science on a scientific historical basis, I want to use this abstract scheme as an analytical tool to review only the characteristic stages of this development and to reduce the analysis to these stages and their strict essentials. This approach should permit me to focus on the theoretical content and significance of this formative process. Of course, I am aware of the disadvantages — not to say perils — of the use of such an oversimplified theoretical model, but I still believe it worthwhile to venture into this experiment. I consider it to be a kind of deductive theoretical experimentation "by — inductive — trial and error".

I.

The brilliant heritage of Demography as a modern autonomous science begins with the performance of *Graunt* in the 1660's[7], i.e. with a spectacular "début", the discovery of a new object or scientific investigation according to the first criterion of *Schumpeter*. Because of the identification of this new scientific field — not to say "territory" — *Süssmilch* compared *Graunt* to *Columbus*[8] and, without a doubt, his wording was justified "a fortiori" so as *Graunt* went one step further.

He applied a methodology suited best to the needs of the new scientific field in the form of massive use of statistics in the study of demographic phenomena or, more precisely, in the study of mortality. From the methodological point of view, *Graunt* was thus fulfilling the requirements of the second criterion by recognizing the advantages of statistics in treating human mass-phenomena from a scientific point of view. However, these phenomena were identified by him as "mortality" and not "Demography" as the title of his book clearly indicates in his reference to the London "Bills of mortality". His cogenius, *Petty*, also stressed the essentials of *Graunt*'s discovery when he dedicated another essay to the "Dublin bills of mortality"[9].

A closer scrutiny of the performance of these two outstanding figures of early demographic thought even reveals that for them — but especially for *Graunt* — it was rather logical to recognize other related demographic phenomena, first of all fertility, implying marriages and births as well as population development. Thus from the point of view of the third criterion, it would be possible theoretically to close the circle, i.e. that of self-recognition — a step, however, which was not undertaken by *Graunt*. This important gap had to wait to be filled in later. Instead the English Political Arithmetics concentrated their efforts on the elaboration of methodology.

From the point of view of the second methodological criterion especially *Petty*'s and *Halley*'s contributions are fundamental: *Petty* by laying the theoretical bases of statistical methodology proper[10] and *Halley* by the application of probability thinking for the first te imto a demographic object[11]. With the help of this calculus, *Halley* developed a table

[7] *Graunt, J.:* Natural and Political Observations upon the Bills of Mortality, With Reference to the Government, Religion, Trade, Growth, Air, Diseases and the several Changes of the said City, London, 1662. 5th enlarg. Ed. ibid. 1676, — in the Economic Writings of Sir William Petty, Ed. by *Hull, C. H.* Reprints of Economic Classics, New York 1963, Vol. II, pp. 314 and furth.

[8] *Süssmilch, J. P.:* Die göttliche Ordnung in den Veränderungen des menschlichen Geschlechts, aus der Geburt, dem Tode und Fortpflanzung desselben erwiesen, Berlin, 1741, Neuausgabe, ibid. 1977.

[9] *Petty, W.:* Observations upon the Dublin Bills of Mortality, 1681, and the State of that City, London, 1683, — in *Hull*, op. cit under 7), Vol. II, pp. 479 and furth.

[10] From the *same Author:* Political Arithmetick, (1672), 1691, in *Hull*, op. cit under 7) Vol. I, pp. 233 and furth.

[11] *Halley, E.:* An Estimate of the Degrees of the Mortality of Mankind, drawn from curious Tables of the Births and Funerals at the City of Breslaw; with an Attempt to ascertain the Price

of mortality, the denomination of which also emphasized the interdependence of demographic phenomena: it showed under his assumptions not only the order of the dying-out of population but also the order of survival. That was the reason, why *Halley* thought it logical to speak of "life-table" instead of "mortality table" and this denomination at the same time pointed not only toward analytical demography, but also toward practical economic applications in insurance.

However, the analytical demographic performance of *Halley* can not be too highly praised from the scientific historical point of view: his life-table calculations implying the problem of the statistical data-basis, at the same time furnished the necessary mathematical approximation of the basic population phenomenon on a probability assumption with the necessary simplifying abstractions. The admission of the hypothesis population development is determined exclusively or "purely" by the demographic variables themselves, for the first time created a model of "pure Demography" in scientific history, and so *Halley* became the first astronomer before *Laplace* and *Quetelet*, who contributed to the formation of an autonomous Demography.

To sum up this first scientific stage of the formation of Demography as an autonomous science, one could say that the object was discovered by „Columbus-*Graunt*" rather as "pars pro toto" than as the totality of population mass-phenomena. The notion of population itself, a "genus proximum" of such a partial population phenomenon as mortality, existed only implicitly in his thought. The essentials of methodology were already present in it, even if only rudimentarily but their connection with probability calculus emerged with *Halley* some three decades later, at the end of the 18th century, which means that the two first criteria were "grosso modo" fulfilled. However the third one, the self-recognition of the new science, was definitely lacking and no proper denomination was found for it at all. As regards the fourth and fifth criteria developed by us, the scientific situation was even more fluid. *Graunt*'s wording concerning his "Natural and political observations" has left open the question of the final theoretical position, whether the new science belongs to the natural or to the political scientific sphere, and there was no trace of institutionalization despite the fact that the framework of the Royal Society was available for such purposes.

II.

The second major step in the development of Demography on the road toward its establishment as an autonomous science may be located around the mid 18th-century, whose major scientific personality was without a doubt *Süssmilch*.

He extended the field of Demography to all basic phenomena of population and circumscribed its object in a systematized and up-to-date sense. The same could be said as regards methodology, life-tables included, but with a marked shift for probabilistically based methodology in the first edition of his "Divine Order" in 1741 toward a more conventional statistical technique in the second edition of 1761—62[12].

of Annuities upon Lives, Philosophical Transactions of the Royal Society. London, 1693, Vol. XVII, Nr. 196, pp. 596 and furth., — and from the *Same Author:* Some further Considerations on the Breslaw Bills of Mortality, by the same Hand with the Former, Ibid., Nr. 198, pp. 654 and furth. — The favorable interpretation of the Halley-Table comes from the monography of the *Author:* Professor Stephen Hatvani (1718—1786) and the Origins of Statistical Science in Hungary, Budapest, 1963 (Hung. text), — *Knapp, G. F.:* Theorie des Bevölkerungs-Wechsels, Braunschweig 1874, pp. 57 and furth. gave a more critical interpretation.

[12] *Süssmilch,* op, cit under 8), 2d Ed., ibid., Vol. I—II, 1761—62, — and *Horváth, R. A.:* Le 200e Anniversaire de J.-P. Süssmilch et la Discipline Statistique, Revue de l'Institut International de Statistique, 1969, Nr. 1.

This "divine order in the changes of the human race" in the second and completely revised edition, revealed more a social order than a natural one and so departed from the original "physico-theological" basis. In the second edition the author entered into the sphere of the nationalistic-absolutist State and its special Prussian social order on the basis of enlightened protestant theology. I have insisted on this specific character of the süssmilchian system already in my early Süssmilch-studies some 20 years ago[13], considering it as an ideological foundation of the enlightened absolutistic monarchy of *Frederic* II. This interpretation of mine is opposed to that of *Bonar* who identified *Süssmilch* as a "God-intoxicated man" and his system as another more developed version of *Derham*'s "Physico-Theology"[14]. Expressed differently, I have identified the second edition of SÜSSMILCH as a fulfilment of the fourth criterion, notably, classifying Demography as a social theory despite the preservation of the fig-leaf of the deterministic "divine order" versus the "recta ratio" of the „aufgeklärter Wohlfahrtsstaat". If his physico-theological slogan had not been retained by the half military — half civil parish priest who *Süssmilch* was, then it would have been quite natural to speak of the "human" or "social" order of population change or "tout court" of a "science of population. This is of course, an unreal hypothesis which historically did not happen this way, but theoretically speaking, *Süssmilch* was very near to this solution, — "a fortiori" so, as he made a considerable progress — toward the ful-filling of the fifth criterion, i.e. toward institutionalization of demographic knowledge.

Notably, he performed in one person the task — so to say — of a whole "European Demographic-Statistical Bureau", when he assembled, ordered and systematized the entire bulk of demographic statistics produced before and in his time for a double scientific purpose. First, it served him to establish the factual basis on the broadest possible scale and to arrive at scientific conclusions on the remote probabilistic foundation of the "great numbers". Second, on this latter scientific basis, he developed at the same time the idea of how to establish population registers for purposes of population policy. It is no wonder that the famous "Populationslisten" of Prussia introduced earlier, flourished under his influence and with his active help in the late 1740's. They were based on vital statistics, but had the secondary aim of establishing the number and characteristics of the actual population, demographic, social, economic, etc.

To conclude: more or less four out of the five criteria were present in the Süssmilchian system, but the most essential formal one: the third, the self-identification of the new science itself was spectacularly missing. This definitely prevented the emergence of an autonomous Demography at this second, Süssmilchian stage of development.

And what I want to stress in connection with this second stage, is the marked step back-ward in comparison to *Halley* by putting aside the probabilistic evolution since the end of the 17th century and especially between the two editions of the "Divine Order". This shift to the disadvantage of probabilistic approach has made it impossible to exploit the great debate on the sex ratio at birth. In this, the physico-theologians and the doctrinaire probabilists were in the same boat, fighting for the equal probability distribution of both sexes, while the statistically minded Political Arithmeticians fought for the admission of the male-surplus birth rate as a "law" on the basis of the accumulating data and in the true spirit of the inversion of the James Bernoulli law. I also want to stress, that *Süssmilch*'s

[13] *Horváth, R. A.:* "L'Ordre Divin" de Süssmilch, Bicentenaire du Premier Traité Spécifique de Démographie (1741—1761), Population, 1962, No. 2, pp. 233 and furth.

[14] *Bonar, J.:* Theories of Population from Raleigh to Arthur Young, London, 1929.

[15] See in this context the recent selective French reedition of *Süssmilch*'s treatise, especially the introductory essays in the first and the *Author's* notes in the second volume: "L'Ordre Divin" de Johann Peter Süssmilch 1707—1767, Aux Origines de la Démographie, Ed. by *Hecht, J.,* Paris INED, 1970, Vol. 1—2

main source on probability, the book of the Dutch philosopher *s'Gravesande,* accepted the equal probability standpoint as a result of „divine intervention"[16], which probably influenced *Süssmilch* against a more outspoken probabilistic attitude.

Looking back to the two early stages of the development of Demography, an additional remark is necessary as regards the fifth criterion of institutionalization. In statistics, the institutionalization was a long-felt need as the considerations of *Petty* and *Leibniz* testify. In France *Vauban* took it up during the same time, but even before the rise of modern statistics, *Seckendorff* had already outlined an idealized model of such a national statistical service, equipped with a whole arsenal of questionnaires. In the mid-18th century, another trend emerged — initiated by *de Moivre* or *Gessner-* and another practical one in the form of the Swedish Tabellverket, the Prussian Populationslisten and later on a similar effort of some other German countries. In this second half of the same century, the French "intendants" produced some elaborate demographic statistics and in some works they even arrived at presenting an overall view of the French population with the help of some complementary estimations, always based on vital statistics[17].

A development in the opposite direction — after some hesitations — is found in the Habsburg Empire under the impact of the German University Statistics and that of the Austrian School of Cameralism. Instead of continous registration of demographic change, the all embracing coverage of the present state of population and its structure was chosen. It was realized first under *Maria Theresia*'s rule in the so-called hereditary provinces, and under *Joseph II* in Hungary, in 1754 and 1784—85, respectively. On this basis, efforts were also made to develop a system similar to the "Populationslisten" by the yearly "revision" of census data. However, this implementation failed completely for lack of trained administrative personnel and because of the political resistance of the privileged nobility, as it happened also in some minor German States. The first censuses were taken in French Canada, as early as 1666 and in the United States, in England and France, in 1790 and 1801 respectively, but censuses in the modern statistical sense are only to be considered those which were taken in the "era of statistical enthusiasm", i.e. from the 1830's on[18]. Curiously enough, the Napoleonic era, which created the first modern centralized state andministration, failed in the statistical field, despite the establishment of a first Bureau de Statistique in 1800. Among the many causes of its failure, the most outstanding one was surely the lack of a scientifically based methodology as well as the lack of organization and division of labor. According to the remaining documents, its staff worked not even according to the principle of a small manufacture, but totally individually on separate problems[19]. So the real incarnation of a statistical office of an average capitalist state turned out to be the Netherlandish bureau under the impact of *Smits* and *Quetelet* in the late 1820's, and, later on, the Belgian counterpart. So it is no wonder that this period coincides with the third stage of the efforts to establish Demography as an autonomous science, — if we leave out of our consideration such isolated efforts as the synthesis of the Hungarian *János Fejes* in 1812, and rightly so, as it remained unknown on the European level[20].

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[16] *S'Gravesande, W. J.:* Introductio and Philosophiam, Metaphysicam et Logicam Continens Leydae, 1736, Ed. Altera: Ibid., 1737, Ed. Sec., Venice, 1748, Ed. Tert., Leydae, 1756. The author was professor of mathematics and philosophy at Leyden University from 1717 till to his death in 1742.

[17] The summary is taken from *Horváth,* op. cit. under 5).

[18] From the *Same Author:* La Hongrie à la Lumière de Deux Recensements — 1784 et 1980, Manuscript of the lecture held in May 1983 in the Hungarian Cultural Institute at Paris.

[19] From the *Same Author:* The Development of the French Official Statistical Service, I—II, Magyar Statisztikai Szemle, 1947, Nrs. 3 and 4.

[20] From the *Same Author:* Les Débuts de la Démographie en Hongrie: János Fejes, Population, 1965, No. 1, pp. 109 and furth.

I think, starting with the analysis of this third stage of the scientific historic development in Demography it is not necessary to evoke the Malthusian debate and to enter into details.

It seems sufficient to sum up its most important consequence: the location of the "principles of population" as an organic part of classic economic theory — following the already existing Smithian tradition, reinforced by *Ricardo* and later by *John Stuart Mill* in the first half of the 19th century[21]. Within this framework a renewal of theoretical effort to create an autonomous demographic science could not be expected: the initiative came again from statistical circles on two parallel, but rather independent lines.

Notably, there were a considerable number of scholars initially interested in demographic statistics, but ultimately also in the overall study of population; some such as *Christopher Bernoulli*, working before the time of *Quetelet,* but mostly at the same time. They were encouraged to try this synthesis, especially because of the gaps of the Quetletian system in this field. The most outstanding effort was without doubt made by *Achille Guillard* in the mid-1850's.

The second line of development is represented by the activity of *Quetelet* himself which falls in this domain and which is completed by scholars belonging to his scientific environment, primarily *Pierre-François Verhulst.* I have dedicated a great deal of effort in my recent research during the last decade to both of these two main currents, and I have presented a summary of my findings in a French paper in 1980[22]. The simplest solution would be to proceed by outlining the summary itself, but this step would have to be linked with the analytic framework developed in this study i.e. with the scrutiny based on the five criteria enabling the whole problem of the formation of Demography as an autonomous science to be carried on one step further.

1. Let us begin by considering the line of thought connected with the personality and impact of *Quetelet* on *Verhulst* 2. and other scholars, — standing at the center of every scientific activity concerning statistics and demography throughout this period which was characterized by *Westergaard* as the "era of statistical enthusiasm", lasting nearly five decades beginning with the statistical activities of *Quetelet* in 1825, and ending with his death in 1874. This wider interpretation seems justified to me because of the fact that *Quetelet*'s activity influenced every major scholar in these fields either positively, or negatively, i.e. by provoking a criticism which became a basis for further scientific development. *Quetelet* succeeded first in applying probability theory to population statistics: among his first results the statistics of mortality and natality of Brussels for the period 1825—26, a life-table of the same city for 1826, a revised version of the latter for 1827, with the collaboration of his friend and disciple *Verhulst,* and the census of the Netherlands for 1829 organized together with *Smits,* are the most important ones. But, of course, the success of the first 1835 edition of his Social Physics was so overwhelming that later on, even those scholars who did not completely agree with him on the formation of Demography as an autonomous science did not hesitate to consider him as its founder. We should mention *Guillard* who, in 1855, spoke of him as the founder "avant la lettre" and, as another example. *Bertillon* in 1876, as *André* pointed out at the occasion of the centenary of *Quetelet*'s death[23],

[21] *Mill, J. St.:* Principles of Political Economy, With some of their Applications to Social Philosophy. London, 1848, 9th Ed. Ibid., 1886, — and several Reimpressions and Translations.

[22] *Horváth, R. A.:* De Christophe Bernoulli à Achille Guillard: Les Tentatives de Création d'une Discipline Démographique Autonome au Milieu du XIXe Siècle, Population, 1980. No. 4—5, pp. 893 and furth.

[23] *André, R.:* Quetelet et la Démographie, in Mémorial Adolphe Quetelet, op. cit. under 3), pp. 74 and furth.

Curiously enough this conviction came about without any equivocation, despite the rather confusing and ever changing facets of his thought and demographic heritage from the theoretical point of view, since his methodological basis of population and vital statistics, including the institutionalization of this field was very strongly developed.

The foundation of this conviction is rooted in the basic scientific ambition of Quetelet to develop a "Science de l'homme" implying in itself Demography as an autonomous science, and by the term "l'homme" he did not mean "l'individu", but the statistical average of population as a mass-phenomenon. The main object was population and the main method demographic statistics according to the two first Schumpeterian criteria, but both of these two criteria were restrictively interpreted in the Queteletian sense. Notably, he insisted in several passages of Social Physics, that he did not want to create a "Theory of population"[24], only to find out with the help of statistics those underlying laws which can be quantitatively brought up on the basis of probability and by analogy to Physics[25]. Another methodological type of limitation derived from Quetelet's definition of statistics as an autonomous science which was based on the Göttingen-School's ideas[26], and one has to agree with Freund that this definition was rather cumulative and not hermeneutic[27]. But — what is more important — at the same time, it placed emphasis on the analysis of "present state" of mass-phenomena, in the spirit of a static and historical analysis, aiming to study "stability" under the influence of permanent causes. The adoption of such a definition was in itself contrary to the development and movements of population over time. From the very begining of his statistical activity, Quetelet as we have seen, had to include the observation of such population phenomena which are covered by the term vital statistics and life-table problems. In following this practice, however, one has the impression that he thought — even if only implicitly — to maintain his theoretical standpoint of 1835, concerning the definition of statistics, namely that "statistical analysis" — I venture to say — "dynamic analysis", being either abstract and mathematical or applied and truly statistical has to proceed on a higher, i.e. "theoretical" level to be considered as a science. Such an interpretation of the second methodological criterion has, of course, a retroactive effect on the first one. Notably, such a methodological standpoint does not permit the treatment of demographic phenomena — or aspects of them in the time, only rigorously, in the long run. That this idea is in line with Queteletian thought is obvious from his tenets on "Theory" itself whose highest level according to him, is that of a "pure" or mathematical theory of "analytical", i.e. functional laws, a rigorous form of science, i.e. "Pure Demography". Correspondingly, and according to this concept, "theoretical demography" should be dynamic, stochastic, if it is statistical, and "a fortiori" so since it should also consider the contribution of other related sciences and specific methodologies, as for example that of economics. We also know that Quetelet, viewing the general evolution of sciences from a scientific-historical aspect, was of the opinion that the "Science de l'homme" had not yet reached this "theoretical" stage[29].

Thus, from the point of view of the first criterion, it seems obvious to me that, in his system the whole field of "demography" had not been fully covered and even methodolo-

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[24] Quetelet, A. L.: Physique Social, ou Essai sur le Développement des Facultés de L'Homme, Bruxelles—Paris—St. Pétersbourg, 1869, Sec. Ed., Vol. I, p. 432 and note 2) and 436 and furth.

[25] Ibid., Vol. I, p. 433, p. 113 and p. 149, and Vol. II, p. 369.

[26] Ibid., Vol. I, p. 102.

[27] Freund, op. cit. under 3), pp. 53 and furth.

[28] Quetelet, op. cit. under 24), Vol. I, p. 432 and note 1).

[29] Horváth, R. A.: Sur les Conceptions Economiques et de Statistique Economique de Quetelet in Quetelet et la Statistique de son Epoque — from the Same Author —, Acta Univ. Szegediens, Jur. et Pol., Tom. XXIII, Fasc. 3, Szeged, 1976, pp. 43 and furth.

gically its possibilities had not been fully exploited[30]. This may be the reason that he was not preoccupied with its denomination and self-identification or with his natural or socioscientific setting, i.e. with the third and fourth criteria, only with the fifth, namely, institutionalization as a major development factor towards a higher and more perfect science. Hence, his concentrated efforts in favor of a further development of demographic statistics on the national and international level. Of these efforts we should mention the first Belgian census of 1846 — later classed by *Levasseur* as the first real scientific census in history —, the subsequent one of 1856, too, and *Quetelet*'s attempt to create a "civil registration" for Belgium from the beginning of the year 1847 and a more "rigorous", i.e. more scientific life-table for that country by geographic divisions in 1853. On the international level, the general idea of *Quetelet* was to organize a series of International Statistical Congresses beginning from that year on the basis of international comparability and the methodological standardization of all statistical material gathered by the national statistical bureaus. However, the idea of creating an International Demographic Statistics, conceived by scientific experts and executed with the participation of national bureaus emerged only at the 1860 London Congress, in the form of a proposal by *Quetelet*. After acceptation of his proposal, he rapidly drafted the necessary plans and began implementing it with the help of *Heuschling* and the Belgian bureau; publications followed in 1866. On his initiative, the same subject was taken up once more from another point of view at the 1867 Florence Congress, when the reliability and the methodology of demographic statistics were scientifically evaluated and, after acceptance, *Quetelet* published his findings and conclusions in the same year[31].

Instead of continuing to review his activity in this field, connected with the fifth criterion, it seems necessary to return to the fourth one, i.e. to the implications of applied demographic theory in the context of the theory of *Malthus:* a problem which *Quetelet* could not totally ignore in his Social Physics. So he dedicated the 7th chapter of the 1st volume to this problem[32], i.e. that of an empirical and applied law, involving at the same time not only a "law of population" proper, but also that of the development of economy, production as well as consumption. As regards population as a variable, he wavered between the pure and the applied approximation, excluding the effects of famines, epidemics and wars; but finally, he stated it empirically: "L'expérience même de notre vieille Europe prouve très bien que les populations arrivent à leur état d'équilibre, ou croissant ou retrogradant en suivant généralement une loi de continuité."[33]. But besides this second, economic variable, he was more preoccupied with social changes, i.e. by change in social structure and social institutions[34] — a very modern idea which has entered into every recent economic growth theory. By abstracting from this latter, *Quetelet* has clearly seen that the Malthusian interrelation may best be measured by production per head and population development by the mean duration of life[35]. Implicit in this is the idea that there may exist — the two variables considered as given quantities — an "optimal" limit between them. Another pioneering idea of his was the analytic line of thought, i.e. that by determining the "pure" population development and the statistical one, we can somehow measure the aggregate effect of the Malthusian "obstacles" or "checks", — an idea which must have originated under the influence of *Verhulst,* — as the adoption of the latter's equations, even without their mathematical form, clearly demonstrates in the second edition of Social Physics[36]

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[30] *Benini, R.:* Principii di Demografia, Firenze, 1901, — gave a more critical interpretation of *Quetelet*'s activity in this field and even accused him to confuse for a while the whole issue.

[31] To compare with *André,* op. cit. under 23) pp. 81 and furth.

[32] *Quetelet,* op. cit. under 24), Vol. I, pp. 430 and furth.

[33] Ibid., p. 434.

[34] Ibid., p. 435.

[35] Ibid., pp. 467 and furth.

[36] Ibid., p. 436, without maintaining *Verhulst*'s name.

2. *Verhulst*'s latest efforts to determine a "population law" date from the year 1844[37] and essentially follow the statistical approximation advocated by *Quetelet* himself, i.e. he abstracted also from random causes and considered only the permanent ones by "cleaning" the series of statistical observations of their "disturbing" effects. According to his thought the development of population was basically determined by fertility and health factors, but also by "custom" and "moral behavior" of population, and thus social and institutional factors have implicitly been taken into consideration. Their contribution as well as that of the economic factor was an unmeasurable one; but it was considered acceptable. His underlying assumption corresponds to the first half of the Malthusian hypothesis, but contains a significant innovation — missing in the Malthusian thinking — the built-in role of the time factor[38]. By starting from an initial population "P" and by choosing two constants "k" and "l" previously unknown, the actual population "p" may be calculated in the form of a simple equation:

$$p = Pk^{lt}, \quad \text{or} \quad p = P\,10^{lt}, \tag{1}$$

representing a logarithmic curve. By supposing that time "t" is equal to "$t = 25$" and $p = 2p$, one can obtain the famous Malthusian formula giving the doubling time of a population, and "l" may be identified with the "potential energy of population growth" in an economically secure state where fear of food shortage does not restrict population growth.

For further determination of the "law of population", *Verhulst* transformed "l" into logarithmic form, introduced a multiplier needed for this transformation in the form of l/m, and identified the latter as the main variable of population development, the diminution of which changes the shape of the logarithmic curve to a logistic one. If we identify "m" with (l+nb), where "b" means the declining state of population development and "n" an indeterminate factor, the equation of the latter may be described as follows:

$$t = l/m \log\left(\frac{p/m - nb}{b/m - np}\right). \tag{2}$$

This second basic equation has an inflexion point at

$$p = 1/2\ m/n$$

according to the underlying hypothesis that the potential energy of population growth is proportional to the growth of the given population and corresponds to a phase of development when the population is in a state of equilibrium. This state was denominated by *Verhulst* as "normal population", in contrast to the state of "surpopulation", defined as "(p−b)". By adding the auxiliary hypothesis that the obstacles of population growth are linearly proportional to the second factor of this surpopulation, *Verhulst*, with the help of a more complicated equation, was able to express this state of non-equilibrium. But he went one step further and, despite many simplifying assumptions and neglected factors, he decided to confront the crude estimation of this population law with reality based

[37] *Verhulst, P.-F.:* Recherches Mathématiques sur la Loi d'Accroissement de la Population, Nouveaux Mémoires de l'Académie Royale de Bruxelles, Tom. XVIII, 1845. (Lu à la Sèance de 30 novembre 1844). This work is an enlargment of an earlier paper entitled: Notice sur la Loi que la Population suit dans son Accroissement, published by *Quetelet, A.,* in Correspondance Mathématique et Physique, Bruxelles, 1838, Vol. XX, — a newer version from the *same Author* with the title: Deuxième Mémoire sur la Loi d'Accroissement de la Population, in Mémoires de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, ibid., 1847, pp. 3 and furth.

[38] The following interpretation corresponds to the paper of the *Author,* entitled: An Early. Mathematical Estimation of Population: The Laws of Verhulst — 1844, 42d Session of the International Statistical Institute, Manila, 1979.

on the population statistics of France and Belgium of the periods 1815—1845 and 1817—1841, respectively. By filling in the gaps and adjusting the inadequacies of these statistical series, *Verhulst*, using the hypothesis that the Belgian population progress was less than arithmetic, obtained — as a kind of early hypothesis testing result — a fair concordance with the Belgian official statistical data using the following equation:

$$p = 6.5837 \frac{z}{1+z},$$
(3)

where $\log z = 0.113785/t\ 0.78060$. As regards France, the approximation of its population law was as good as the Belgian one on the basis of a similar equation:

$$p = 0.139/t + 3.437 = \log \frac{p}{39.685 - p}.$$
(4)

Despite their good approximation, *Verhulst* considered these laws as "indeterminate" since he was unable quantitatively to determine the obstacles to population growth. To him, it was more important to determine the "population maximum": the most relevant goal of population policy. He argued that this state had been at the center of interest of all population policy aspirations from *Plato* and *Aristotle* on, and that with its help, the rather unproductive Malthusian line of thought might be avoided. But this did not happen: *John Stuart Mill* took no notice of *Verhulst*'s results in his "Principles" of 1848, which became the "Bible" of economists for four decades, until the appearance of *Marshall*, and even the statistically inspired demographers of the group outside *Quetelet*'s circle ignored it as well.

3. The most striking example of this may be the late and — according to this subject — the most interesting character of his family[39], who historically was also the first to initiate such kinds of investigations, *Christopher Bernoulli. Bernoulli* was a descendant of the illustrious family of Basle-scholars. He began his scientific career at the beginning of the 19th century as a professor at the university of Halle and later of Ulm, and he finished his career as a professor in Basle[40]. Not surprisingly, he was strongly influenced by *Süssmilch*, and the Descriptive Statistical School of Göttingen; but he also felt strong need to renew both of them from the theoretical point of view. In this latter field, he clearly foreshadowed the very idea of *Quetelet* himself in his short paper of 1804 entitled "In Search of a Physical Anthropology". In this work, he stated the necessity to formulate the "laws" of essential human physical change with the help of "population statistics", the basis of which is the given state of population in the sense of the Göttingen School, and not vital statistics. Thus, this early pioneering paper showed all the essential elements of the later Queteletian conception of population. However, the publication of the main study of *Quetelet* in 1835 revealed to *Bernoulli* that the former's performance did not satisfy the requirements of an

[39] The *Bernoulli*-family gave eight or nine mathematicians to the scientific world in three generations — according to the International Statistical Encyclopaedia, Ed. by *Kruskal, W. H.* and *Tanur, J. M.*, New York—London, 1978, Vol. I, Title-word: "Bernoulli", p. 18, — but according the Author's interpretation, from them only five were contributing to statistics and demography: James, John, Nicholas, Daniel and Christoph, — the latter being the fifth. From them, Nicholas (first under this name) living from 1687—1759 was the first editor of James' "Ars Conjectandi" as his nephew and worked together with S'*Gravesande* on the problem of the sex ratio of births raized by *Arbuthnot*. Nicholas I represented the "a priori" probabilist tenet that this probability has to be equal to 1/2 and the deviations may be attributed only to the not enough great numbers and the defectiveness of the records.

[40] A more detailed presentation by the *Author* in op.cit. under 22).

autonomous Demography, and so he published his own ideas under the explosive German title "Handbuch der Populationistik" in 1841[41]. This germanized Latin term created by him was the first conscious effort of self-identification of Demography as an autonomous sceince, according to the Schumpeterian third criterion, even if the "genus proximum" of the new science was not clearly delimited, but adopted by his inventor "faute de mieux".[42]

Its content relates to "Völker- und Menschenkunde nach statistischen Ergebnissen" i.e. "Ethnography including nations and people based on statistics." Mentioning statistics as the principal method of human mass phenomena is in conformity with the second methodological criterion, even if it is restricted to the present state of population in this first approximation by establishing relations of sub-populations and population structure. The "science of population" or the "doctrine" on this basis falls into two distinct parts according to *Bernoulli:* "General Populationistik" and a "Special" one. They are distinguished by an abstract and a concrete level of theoretical analysis: the first part consists of a synthesis of the findings by not taking into consideration space or time, while the second part analyses mostly populations within their space and with their structure and also vital statistics, i.e. the dynamics of populations, including life-tables. To *Bernoulli,* the second part may be identified with "Bevölkerungskunde" or "Ethnography" but with differentiation in respect to the verbal "Ethnographic method" of the old Göttingen-School: population must be described quantitatively, based on "scientific", i.e. modern and reliable statistics in the Queteletian sense. Obviously, this second part constitutes essentially population statistics on a national level, with the proper techniques as they have been in existence since the early 1840's without any innovation. However, the theoretical first part of *Bernoulli*'s treatise is more than a deception: it is giving nothing else than European averages of the main demographic variables on a five-year basis, drawn from the material of the second part. The only theoretical remark of some value consists of his denomination of the life-table problem as "a biometry of population", even if these problems form only a minor part of it.

That *Bernoulli* himself was not satisfied with his own results, is clearly shown by an additional volume published two years later as a kind of "Supplement", foreshadowing the Queteletian institutionalization — and by another short essay entitled "Some Words on Anthropological Statistics" from a year earlier[43] In the latter, he again tackled the theoretical problem, being aware that despite having found the main method, the denomination and the object of population studies, something essential was still missing from a "Scientific Demography", corresponding to "Anthropological Statistics" in the sense of the physical laws of Queteletian science on the basis of great numbers. As *Bernoulli* rightly felt, *Quetelet* failed to form a "pure theory" on the basis of "demographic" variables and their corresponding scientific laws, therefore he ventured to study the interrelations of population with complex social phenomena to find a proper theoretical domain. As a result, he interpreted the first criterion only in the sense of the fourth and tried to create a Demography of an applied social science without knowing the basic "pure" theoretical relationships. So despite the presence of all five criteria the confusion between the first and fourth requirements prevented any final solution. This is, in sum, the result of *Bernoulli*'s theoretical efforts.

[41] *Bernoulli, Chr.:* Handbuch der Populationistik, oder der Vöker- und Menschenkunde nach statistischen Ergebnissen, Ulm, 1841, — and the earlier paper from the *Same Author:* Versuch einer physischen Antropologie, Halle 1804.

[42] *Christoph Bernoulli*'s priority for the denomination of Demography — even if only by a German term — was emphazised recently by *Winkler, W.:* Demometrie, Berlin, 1961, p. 18.

[43] *Bernoulli, Chr.:* Neuere Ergebnisse der Bevölkerungsstatistik, Zugleich als Nachtrag zum Handbuch der Populationistik, Ulm, 1843, — and from the *Same Author:* Einige Worte über antropologische Statistik, Basel, 1842.

His failure is fairly obvious to us with our up-to-date knowledge, but was not so evident to his contemporaries who were convinced by his justified criticims against the gaps in *Quetelet*'s system and so the negativeness of his results was hardly realized. This applies especially to the German economist,*Wilhelm Roscher* in the mid-1850's. That Demography has more to do than to treat the Malthusian "Principles of Population" as represented in the political economy of *John Stuart Mill,* was evident to him under strong influence of *Bernoulli.* But as an economist, he wanted to solve this problem within the framework of economics, and so he incorporated Demography — one is inclined to say — as an "auxiliary science" of economics into his "Foundations", published in 1854[44]. On two demographic points he went even further than *Bernoulli:* first, by extending the sphere of population statistics to the past and not only to the present and retaining this subject under the denomination "Population History" and complemented with the separate study of "Population Policy"; and second by trying to establish mathematical formulas for "Population Theory", but almost solely in the Malthusian, i.e. social economic context, exactly as in the system of *Bernoulli.*

Roscher's book was translated into French in 1857, into English in 1878[45] and by the end of the World War I some 22 editions of it were published, despite its obvious failure to solve the crucial theoretical problem and the difficulties regarding the position of Demography as an autonomous science.

In 1855, just one year after the publication of *Roscher*'s book, a French book was published by *Achille Guillard* which had several merits from our special point of view, the most obvious being the introduction and first use of the actual denomination of the new science, i.e. "Demography"[46]. The importance of scientific activity and the background of this author has already been discussed by *Bernard-Pierre Lecuyer*[47] at a preparatory workshop lecture at the ZIF in the summer of 1981, and the main results in his publication have been summarized. According to *Lecuyer*'s interpretation, he "became internationally famous and is almost uniquely remembered today for his coining of the current word of demography", and *Lecuyer* affirms also that his book had a wide circulation. This accepted, and knowing the high aspirations of *Guillard,* no more and no less, than to solve once and for all the problem of establishing Demography as an autonomous science, one wonders why his effort was not crowned by success! I believe the critical apparatus provided in the form of the five criteria could be useful in the elucidation of this problem.

Let us begin with the self-identification criterion, with the successful coinage of the definitively accepted term of "Demography". "It is interesting in the "Foreword to the readers" of *Guillard* that he had serious difficulties with his editor concerning the denomination when he wanted to use it as title of his treatise. The objection was that *Guillard*'s word and the corresponding science had never been heard of, and consequently nobody would buy such a book. In view of these arguments and the iron determination of the publisher *Guillard* had to give in and alter the title to "Eléments de statistique humaine ou Démographie comparée"[48]. This transformation gave a character of simple population statistics to the book, i.e. that of a rather well known subject which was in sharp contrast with the scope and significance intended by the author. Certainly, *Guillard* states in the

[44] *Roscher, W.:* Grundlagen der National-Ökonomik, Leipzig, 1854.

[45] The French edition was published under the title: Principes d'Economie Politique, Traduit sur la 2e édition allemande (1856) par *Wolowski, L.,* Paris, 1857, An English Edition under the Title: Principles of Political Economy, Translated by *Lalor, J. J.,* London, 1878, followed.

[46] *Guillard, A.:* Eléments de Statistique Humaine ou Démographie Comparée, Paris, 1855.

[47] *Lecuyer, B.-P.:* Probability in Vital and Social Statistics: Quetelet, Farr and the Bertillons, — in Probability and Conceptual Change in Scientific Thought, Ed. by *Heidelberger, M.* and *Krüger, L.,* University of Bielefeld: 22d Report, ZIF, Bielefeld, 1982, pp. 185 and furth.

[48] *Guillard,* op. cit. under 46, Avis du Lecteur, pp. V and furth.

foreword that he wants to base "the principles" of the new science denominated by him "on the statistics of the present state and movement of population". So there can be no doubt that the second and third criteria are fulfilled, but the problem remains again with the interrelation of the first and the fourth ones. In *Guillard*'s system the object is the population as a mass phenomenon, with its structure and changes, but the specificity of the point of view, even if he recognizes that it should be treated as a "pure theory" of population, — using only the demographic phenomena as variables —, has remained unsolved in the thinking of *Guillard*. This failure was a direct consequence of his having followed the traditional line of development in demography instead of concentrating on the truly revolutionary innovations on the theoretical basis, as with *Quetelet* and *Verhulst*. *Guillard* more or less adhered to the heritage of *Süssmilch* and *Malthus*, of *Bernoulli* and especially *Roscher;* the result was therefore very similar to the solution of these latter systems, i.e. an applied "socio-demography". So he insisted once again on the idea of the necessity of comparisons on the national level, i.e. a kind of substitution of the essentials of the first criterion with the fourth, and all this in a confused manner, — as it happened in the case of *Bernoulli* and *Roscher*. This was the end-result despite tremendous correspondence on *Guillard*'s part with such reputed contemporary statisticians and economists as *Villermé*, *Block*, *Bertillon* or *Du Puynode*, though of which *Quetelet* and *Verhulst* are conspiciously missing. As the correspondence shows, these scholars spent a considerable effort on dealing with the mathematization of pure theoretical interrelations in Demography; but they were not able to rid themselves of the social theoretical context, in other words the Malthusian vicious circle. The Annexe of *Guillard*'s book in which he published the related material clearly demonstrates this aspect[49].

In this respect, the revival of *Guillard*'s performance by his son-in-law, *Louis-Adolphe Bertillon,* in 1876, at the Royal Academy of Medicine in Brussels[50], was not much help, either. As *Lecuyer* has rightly interpreted, these were no more than some "theoretical and methodological considerations pertaining to *Quetelet*'s thought, the nature of demography, the role of statistical and quasi-probabilisitic reasoning"[51]. I would like to add that in this inaugural lecture *Bertillon* declared the denomination of the new science by *Bernoulli* as "populationistique" — cited by him with French orthography — and as "euphonique", and the term used by *Quetelet* in the form of "Physique Social" as too large, embracing not only people but whole societies. Thus, this is identical with "Sociologie" —, even if it is restricted to that part of social science which is accessible to the observation method, i.e., to demographic statistics. After insisting on a separate place for Demography among the autonomous sciences, *Bertillon* agreed with *Quetelet* on the basic tenet that the theory of that new science must be rather "biological" or "natural" with corresponding "deterministic-probabilistic laws". Thus he was implying that the study of society from the point of view of moral and intellectual properties of human collectivities belongs to sociology proper in the form of an "applied Demography", as referred to also by *Lecuyer*.

IV.

Nearly at the same time with the rather furtive attempt by *Bertillon* in Brussels in 1876, a very efficient new initiative was taken by the German professor *Georg Friedrich Knapp* to establish Demography as an autonomous science. His efforts opened up a new era:

[49] Ibid., Annexe.
[50] *Bertillon, L.-A.:* Considérations Générales sur la Démographie, Appliqué tout particulièrement à la Belgique, Bulletin de L'Académie Royale de Médecine de Belgique, 1876, 3e Série, Tome X, Bruxelles, 1876, pp. 749 and furth.
[51] *Lecuyer,* op. cit under 47), pp. 207 and furth.

an era in which efforts were crowned with success. In his treatise published in 1874, entitled "Theorie des Bevölkerungs-Wechsels"[52], i.e. theory of "population change", *Knapp* gave a very detailed evaluation of earlier developments in Demography prior to his own activity.

He divided the previous development into two distinct periods, the first being Political Arithmetics and the second a kind of "Bevölkerungskunde" or "knowledge of population" but this latter still not having reached the stage of a truly scientific, i.e. theoretical phase of development. During the second period, according to his analysis, there were two outstanding attempts from the theoretical point of view: that of *Malthus*, trying to establish Demography as a social science, even if incorporated into Political Economy; and that of *Quetelet* who wanted to lay the foundations of this science as a natural science. However, both these attempts failed one decade before *Knapp* as the book of *Wappaeus* had already stressed this fact[53], — to which *Knapp* had referred. So *Knapp* tackled the problem again and found as the dividing-line between the two former periods of development a sharp distinction between the analytic concepts of "stationary" and a "developing" population. The Political Arithmeticians exclusively used the former concept, and the first scholar who recognized the importance of this conceptual difference was *Fourier*, when he analyzed the problem of mortality with the help of life-table techniques in the years 1821—23[54]. He saw clearly that all previous tables started from the hypothesis that the numbers of births and deaths during one year were equal and that there was no migration to disturb this "stationary population" pattern. Thus, this hypothesis served as a basis of simplified analysis, and even more so as the changes within time of a given generation were not recognized.

According to *Fourier*, three kinds of sub-population have to be distinguished: first, one has to separate the sub-population of deceased persons in one given generation, i.e. who were born in the same year, from those who died also in the same year. The second sub-population is composed of the survivors of the same generation alive between two given dates, the latter necessarily living longer than the length of a calendar year. The third subpopulation corresponds to the concept of the second one, but comprises the number of persons deceased from a given generation between two corresponding dates as before. The discovery of this important analytic step opened the way to the recognition of „non-stationary population patterns", primarily that of the so-called "stable population" and move on to the so-called "dynamic populations". *Fourier*, being fully aware of the importance of his discovery, refused, however, to enter into these "complicated calculations" and hinted only at the theoretical perspective opened up by his investigations[55].

[52] *Knapp, G. F.:* Theorie des Bevölkerungs-Wechsels, Abhandlungen zur angewandten Mathematik, Braunschweig 1874. — In reality in this treatise *Knapp* published three separate papers with the following titles: 1) Mathematische Darstellung der Theorie des Bevölkerungs-Wechsels mit Rücksicht auf die Unstätigkeit der Funktionen, 1870, pp. 1 and furth. — 2) Geschichte der Theorie des Bevölkerungswechsels, 1872, pp. and furth. — 3) Allgemeinere Sätze über die Gesamtheiten der Verstorbenen, 1873, pp. 105 and furth. Beside a correction to paper 1), — from our special point to view an annex to paper 2) under the title: Beilagen zur zweiten Abhandlung on pp. 121· and furth. has so far interest that in it *Knapp* undertook to explain the corrections of the Halley Table.

[53] Ibid., p. 56 not 1), with reference to *Wappaeus, J. E.:* Allgemeine Bevölkerungsstatistik, Leipzig, 1859—61, — a work which was classified by *Knapp* as a rather interesting collection of demographic statistical material, without theoretical implications.

[54] Ibid., pp. 78 and furth., — with reference to *Fourier, Chr.:* Recherches sur la Ville de Paris et le Département de la Seine, Paris, 1821, Sec. Ed. ibid., 1823, published as Vol. I of the anonym paper of *Fourier* under the title: Notion Générales sur la Population, pp. 9 and furth. — His following, publications of demographic interest in the same series: Mémoire sur les Résultats Moyens déduite d'un grand nombre d'Observations, in Vol. III, 1826, pp. 9 and furth. — and Second Mémoirs sur les Résultats Moyens et sur les Erreurs de Mesure, Vol. IV, 1829, pp. 9 and furth.

[55] Ibid., p. 87.

In his subsequent considerations, he went rather, backwards by adopting the assumption of *Deparcieux* from the middle of the 18th century, that every member of the same generation was born on the same day, in mid-year, and died out in the same fashion and in equal amount, and so he arrived at a stationary population. In this case, the life-table, in correct theoretical terms, gives the order or "law" of dying-out and the order or "law" of surviving of the whole population. In his critical appraisal, *Knapp* added that for this case, these laws could be represented graphically by curved lines on a Cartesian plane[56], as *Becker* and *Zeuner* had done some years before him. The latter went even further than this, by applying a spatial representation with three axes to visualize better the interdependencies of population change[57]. *Knapp* has nothing but praise for the work of *Zeuner* and his lucid analysis of the problem as well as for a verbal analysis by *Becker* of the same problem, which theoretically was also valid and even more systematic than those by his contemporaries[58].

It is difficult to ascribe these discoveries exclusively to the above-mentioned scholars; for instance, the achievements of *Lexis* in this field are similarly great. *Lexis* described the curve of mortality more precisely than anyone before him and popularized the graphical representation of the three sub-populations as an every-day tool of demographic analysis so effectively that even in many textbooks of today this method is associated with his name[59].

The analysis of *Knapp* was a pioneering one insofar as he also reviewed the activity of *Quetelet* from this special point of view. *Knapp* emphasized that *Quetelet* realized by purely statistical reasoning the presence of the diverging movements within the same generation and he also took into consideration the positive or negative balance of migration, i.e. he abandoned the migration balance assumption being equal to zero; so he was nearing to the concept of stable population even without separating the three sub-populations in his life-tables of the years 1851, 1853 and 1864[60]. The studies of *Becker,* in the subsequent years of 1867—1872, were started partly of this Queteletian experience.

Knapp completed this study also with a critical historical part. In it, he tried to review the whole development of Demography under the special theoretical and methodological aspect and, among other things, he made great efforts to find out how *Halley* had rectified the Breslaw-data. Regarding this latter problem, — the "smoothing of data" — *Gompertz* in 1825 and *Makeham* in 1860, quite unnoticed by him, made considerable progress[61]. All these developments in pure demographic methodology only influenced theoretical demographic development at the turn of the century, when the writings of *Bortkiewitz* were already available and gave a clear-cut and comprehensive synthesis of the recent development in this field.

During this period, around the turn of the century, the methodological development was a very marked one, despite the fact that even outstanding scholars failed to piece together every aspects of this difficult process. The index-number methodology, for example,

[56] Ibid., p. 27, figure 1.

[57] Ibid., pp. 100 and furth., with reference to *Zeuner, K.*: Abhandlungen zur Mathematischen Statistik, Leipzig, 1869, — and to *Knapp*'s essay from the same year entitled: Sterblichkeit in Sachsen Leipzig, 1869.

[58] Ibid., p. 96, with reference to *Becker, K.*: Statistische Nachrichten über das Grossherzogtum Oldenburg, Beschreibung der Bevölkerung, 1. Theil, 1867, — 2. Theil 1870, — 3. Theil, 1872, hg. vom Statistischen Bureau — and from the *Same Author:* Preussische Sterbetafeln, Zeitschrift das königlich preussischen Statistischen Bureaus, 1869, Nr. 4—6.

[59] *Lexis, W.:* Einleitung in die Theorie der Bevölkerungsstatistik, Strassburg, 1875, — and from the *Same Author:* Über die Theorie der Stabilität statistischer Reihen, Jahrbücher für National-ökonomie und Statistik, 1859, Nr. 32 — and from the *Same Author:* Bevölkerungswesen, II: Bevölkerungswechsel, in Handwörterbuch der Staatswissenschaften, Vol. 2, pp. 463 and furth.

[60] *Knapp,* op. cit. under 52), pp. 95 and furth.

[61] The importance of their work was emphasized already by *Westergaard,* op. cit. under 6), — and recently by *Winkler,* op. cit. under 42), pp. 26 and furth.

was ingeniously adapted to population analysis, independently by two scholars, *Ogle* and *Kőrösy*, under the name of "standardization" of age distribution[62]; but the utilization of the stable-population concept and the generational analysis — the later „cohort-analysis" — in the Hungarian offical demographic statistics by *Vizaknai* was not noticed even in the leading methodological circles[63].

At the turn of the 19th and 20th centuries, the whole development of Demography on the road toward autonomy was once more characterized by a swing toward the social scientific implications of Demography; i.e. towards the Malthusian question. In neo-classical English Political Economy, the long-term trend corresponded to the maintenance of the "Principles of population" in the form given to them by *John Stuart Mill*, notably, by implementing them with *Senior*'s so-called "second postulate", with the "law of the diminishing returns of land"[64]. This version was still incorporated into the system of *Marshall* and the leading scholars of the marginalist thinking, especially *Böhm-Bawerk* and *Walras* explicitly accepted it[65].

At the same time, in the German literature on economics, *Oppenheimer* gave a critical appraisal of the tenets of the leading German economists analyzing mainly the works of *Roscher, Mohl, Rümelin, Wagner* and *Elster*. He offered criticism of his own by stating that the Malthusian law could not be interpreted in the original "tnatural law" concept, but only as a "social and economic law", — the solution of which had to be found in the socialization of land[66]. However, the most important contribution of this critical period consisted of the tenets of the Swedish economist *Wicksell* who, in 1910 formulated a theory of "population optimum", strongly supporting the freshly emerging view in Western Europe that the European capitalist system exhausted its natural economic basis and was nearing the point where population development should somehow be restricted[67]. This controversy came up once more and with much more publicity at the end of World War I, when *Keynes* launched his bitter criticisms of the peace-treaties ending the war. In his famous book of 1920[68], he was of the opinon that the economic consequences of the European peace-treaties were destroying the established economic order of capitalist Europe and thus increased the effect of the earlier slowing-down effect of economic and population development attributed to a revival of newly emerging Malthusian phenomena. The German economist *Mombert* — quite independently of *Keynes* — analyzed the consequences of the defeat

[62] *Kőrösy, J.:* Über die Berechnung einer internationalen Sterblichkeitsmaße, Jahrbücher für Nationalökonomie und Statistik, 1893, 3. F. VI.

[63] *Acsády, G.:* The Demographic Acitivity of A. Vizaknai in the Hungarian Offical Statistical Service, — Manuscript of a lecture given in the Hungarian Statistical Society in 1970. (Hungarian text).

[64] *Cannan, E.:* History of the Theories of Production and Distribution in English Political Economy, London 1893.

[65] *Schumpeter,* op. cit. under 2) pp. 889 and furth.

[66] *Oppenheimer, F.:* Das Bevölkerungsgesetz des T. R. Malthus und der neueren National-ökonomie, Berlin—Bern, 1901, — the critics of German representatives in Chapter III, pp. 66 and furth.

[67] *Wicksell, K.:* Das Optimum der Bevölkerung, 1910, — which is, according to *Sauvy*, the first exposition of this theory, whereas *Robbins* dates it to 1913, published in the German translation of *Wicksell*'s lectures on Political Economy. See later under note 84) Vol. I, p. 51 and note 71). A short Swedish paper on the same problem was published in 1916 and included under the title: The "Critical Point" in the Law of Decreasing Agricultural Productivity — into his Selected Papers on Economic Theory, Ed. by *Lindahl, E.,* Reprint, New York, 1969, pp. 131 and furth. — The latter gave a short appraisal of *Wicksell*'s population ideas in his: Introduction, Wicksell's Life and Work, ibid., pp. 35 and furth.

[68] *Keynes, J. M.:* The Economic Consequences of the Peace, London, 1920, — Preface from November 1919. — On p. 8 with the famous exposition: Malthus disclosed a Devil... Now perhaps we have losed him again."

from the German point of view and, recognizing the relatively modest posibilities of population policies in the face of population pressure among deteriorating economic conditions, he argued in favor of a rationalization and increased productivity of the postwar German economic system[69]. The thesis of a population slow-down proposed by *Keynes* especially for the pre-war period was seriously attacked and rejected by *Beveridge,* but in conclusion he accepted the growing importance of the population problem in the post-war world[70] without realizing the importance of an autonomous Demography in the scientifically valid solution of the whole controversy. This is also true of the contribution of *Lionel Robbins* of 1927 in which he tried to prove the thesis that *Wicksell*'s optimum theory of population was subsequently, from 1888 on, developed independently by *Edwin Cannan* and explicitly formulated in 1914[71]. The only English contribution of this period, written in a true demographic spirit, was an article by *George Udny Yule* in 1925, dealing with the problem of "Growth of population and the factors which control it"[72].

The whole slow-down was interpreted by later demographers autonomously under the term of "demographic transition" as a uniquely demographic phenomenon, entirely due to the progress of social medicine and organization, and only to a lesser degree to increasing economic wealth.

The origins of this development had already been signalled in the treatise of *Verhulst* relating to France and Belgium and on the basis of the population statistics at the end of the 19th century, demographic statisticians gave wide publicity to the problem and supported te so-called "populationist" movement. This was especially visible in France where the catastrophic losses of World War I gave a further and reinforced impetus to the whole "population problem" and carried the controversy on this issue over into the inter-war period.

The declining and consequently deteriorating population development alarmed French public opinon once more after World War I especially in the period of the great economic crisis of the early thirties. The growing weight of this problem lead to the publication of *Adolphe Landry*'s "Demographic revolution" in 1934[73] which had a decisive influence on the establishment of Demography as an autonomous science. *Landry* was more an economist and political philosopher, but became a real demographer through the intellectual challenge of finding a valid solution for his country by analyzing and elucidating the whole context of the problem on a solid scientific basis, i.e. valid also for Europe and the whole

[69] *Mombert, P.:* Die Gefahr einer Überbevölkerung in Deutschland, Tübingen, 1919. — In reality this author was already stating the problem during the war, — according to p. 2. — under the title: Bevölkerungspolitik nach dem Kriege, Tübingen, 1916. — A renewed version under the impact of the great economic crisis of the 1930ies was published under the title: Bevölkerungsentwicklung und Wirtschaftsgestaltung, Zur Frage der Abnahme des Volkswachstums, Leipzig, 1932.

[69] *Beveridge, W.:* Population and Unemployment. The Economic Journal, December, 1923, pp. 448 and furth., — and *Keynes*' rejoinder under the title: A Reply to Sir William Beveridge, ibid., pp. 476 and furth., — where he is referring not only to his op. cit. under 68) but also to his opinion expressed in the Economic Journal in 1912, Vol. XXII, p. 630, interpreting the data of *Bowley,* published in the same journal, in 1903, Vol. XIII, p. 628 and furth.

[70] *Beveridge*'s final contribution to this discussion was published under the title: Mr. Keynes' Evidence for Overpopulation, ibid., 1924, Nr. 3—4, pp. 2 and furth.

[71] *Robbins, L.:* The Optimum Theory of Population, in London Essays in Economics: in Honour of Edwin Cannan, Ed. by *Gregory, T. E.* and *Dalton, H.,* London, 1927, pp. 103 and furth., — with reference to *Cannan, E.:* Wealth, London, 1914. — *Robbins* referred to *Wicksell*'s theory from his "Vorlesungen...", published in 1913.

[72] *Yule, G. U.:* The Growth of population and the Factors which control it, Journal of the Royal Statistical Society, 1925, Vol. 88, pp. 1 and furth.

[73] *Landry, A.:* La Révolution Démographique, Etudes et Essais sur les Problèmes de la Population, 1934, Reedition by the Institut National d'Etudes Démographiques, Paris, 1982.

115

world. In a reprint in 1982 of the basic work of *Landry,* the professor *Alain Girard* insisted[74] that his success in the establishment of Demography was largely due to his perspicacity regarding the most recent methodology developed by demographers and statisticians. The important distinction made by *Robert René Kuczynski* concerning the crude and net rate of mortality, natality and reproduction, his utilization of mean life duration for different cohorts, and especially *Lotka*'s elegant presentation of the concepts of stationary and stable population and their development into different "population types", essentially of a dynamic nature, were definitively incorporated into the methodology of Demography by *Landry*[75].

I want to stress the fact that, later on, in 1945, *Landry* arrived at incorporating into the demographic manual edited by him, as a contributor, two chapters on the "pure theory of Demography" and also the "Law of population". In them, he referred critically to the work of the two American authors *Pearl* and *Reed,* who, at the beginning of the 1920's, took up the problem of *Verhulst* and calculated the logistic curve of the United States Population growth from 1790 on[76] which *Landry* compared with the corresponding curve for France[77], with a conclusion of a sociological rather than pure demographic character, according to his tenets from 1944 on.

But the high standards of demographic statistics in the 1930's already permitted *Landry* to review population development in his 1934 treatise. In the long run, he found the findings of *Verhulst* mentioned earlier to be true and the tenets of *Keynes* also referred to as approximately correct, according to his own historical demographic analysis. This permitted him to develop three main stages of population development, by elaborating the ideas of *Warren S. Thompson* another American scholar, put forward in the years 1929 and 1930[78]. The latter differentiated three types of populations, according to the interrelation of mortality and natality indices, which served *Landry* as a basis of generalization for the whole problem of population development. He distinguished the traditional "ancien régime" in demography from the revolutionary new contemporary one and spoke of the latter as "demographic revolution" in the true sense of the world, and showed only a historical interest in the socalled "transition period" between them. In doing so, he clearly preceded even other American scholars, especially *Frank W. Notestein* who launched this term in 1945, and *Ansley C. Coale* and his extended regional studies in the 1970's[79]. They were concentrating their efforts to explain the transition process itself and were looking for a kind of equilibrium situation following it, whereas *Landry* considered the actual

[72] Ibid., in the Reedition: Présentation *d'Alain Girard,* pp. 1 and furth., esp. pp. 11 and furth.
[75] *Kuczyinski, R. R.:* Fertility and Reproduction, Methods of Measuring the Balance of Birth and Death, New York, 1932, — and from the *Same Author:* The Measurement of Population Growth, London, 1935.; *Lotka, A. J.:* Elements of Mathematical Biology, New York, 1925., — This author collaborated also to another important demographic contribution to the life table problematics,— to comp. with *Dublin, L. J.—Lotka, A. J.—Spiegelman, M.:* The Length of Life, New York, 1936.
[76] Traité de Démographie, Ed. par *Landry, A.,* Paris, 1945, 2e Ed. ibid., 1949, Chapitre VII: La Démographie Pure, pp. 487 and furth., — and Chapitre VIII: A la Recherche d'une Loi de la Population, Le Facteur Economique, pp. 517 and furth., especially 534 and furth., — with reference to *Reeds*'s name. In reality *Pearl, R.—Reed, L. J.:* On the Rate of Growth of the Population of the United States since 1790 and its Mathematical Representation, Proceedings of the National, Academy of Sciences, 1920, Vol. VI., Nr. 6.
[77] *Landry, A.:* La Statistique en Démographie, in La Semaine Internationale de Synthèse, Paris, 1944, — cited by *Vitaloux, J.:* Le Peuplement Humain, Paris, 1959, Chapitre XXI: Démographieet Sociologie.
[78] *Thompson, W. S.:* Population, American Journal of Sociology, May 1929, Vol. XXXIV pp. 959 and furth, — and from the *Same Author:* Population Problems, New York 1930.
[79] *Notestein, F. W.:* Population, The Long View, in *Schultz, T. W.:* Food for the World, Chicago, 1945, pp. 36 and furth., — and *Coale, A. C.—Hoover, E. M.:* Population Growth and, Economic Development in Low Income Countries, A Case Study of Indian Prospects, New York 1959.

revolutionary situation which was still going on and developing toward possible demographic catastrophes as in the ancient civilizations — a problem to which he devoted the second part of his studies[80].

Landry was of the opinion that the population transition came parallel with the betterment of economic conditions in France — and in Western Europe — and also accepting the major contribution of medicine, social hygiene and social conditions in general to the so-called "rationalization of human life", he found its basic cause in the voluntary limitation of natality. Its motivation — according to this late moral philosopher — need not be entirely egoistic, one could imagine a kind of family planning favoring a better educated and better financed progeniture; but he feared a marked reinforcement of this tendency in the near future, leading to collective, i.e. national catastrophes. On the basis of his understanding of the pure theory of population and with the outspoken help of the proper demographer *Alfred Sauvy, Landry* was undertaking a "mighty synthesis" concerning its social impacts. He advocated social progress through the maintenance of population development by two essential means: Demography as an autonomous science influencing public opinion, and a population policy in favor of family allocations. The first heading covers all his efforts to create an up-to-date manual of Demography, first published in 1945 and republished in 1949 with the help of the best French scholars of Demography[81], and the creation of a demographic research institute in 1945, the famous "Institut National d'Etudes Démographiques"; the second concerns the legislation in favor of the family-allocation system and the change in the declining French population development trend during and after World War II. But the "mighty synthesis" implied even more than this. As *Landry* was deeply aware of the growing sociological implications of this new science, he tried to establish links with Sociology proper, especially after the publication of *Maurice Halbwachs'* treatise on "Social morphology" in 1938[82], whose conception was very close to a real applied social Demography. Consequently, *Landry* did not hesitate in 1944 to declare Demography a branch of sociology, and the first Director of the French Demographic Institute, *Sauvy,* confirmed the necessity to work in harmony and close cooperation with other sciences, social or natural[83]. The fulfilment of this program in the subsequent decades was impressive. I only want to refer to the "General Population Theory" of *Sauvy* himself in two volumes, to the "Demographic Analysis" of *Roland Pressat,* both in several editions, and the works concerning the population genetics of *Georges Malecot, Jean Sutter* and *Leon Tabah*[84], parallel with basic works in the history of demographic ideas, Historical Demography and Economic Demography.

This rather lengthy exposition of developments in France is especially instructive since it shows the presence of all five criteria and the deliberate determination to utilize them together to create a new science for the needs of the radically changing social climate. From this point of view, the brilliant theoretical initiatives beginning with *Knapp's* activity in Germany were rather inconclusive. *Von Mayr, Rümelin* and the Hungarian *Körösy* considered "Pure Demography" to be a biological science, and they proposed to exchange

[80] *Landry,* op. cit. under 73), Reedition, Deuxième Partie: Dépopulation et Décadence, pp. 107 and furth. In this part *Landry* analyses the problem in Ancient Greece and Rome, compares it with his own time and draws his conclusions.

[81] Comp. with *Girard,* op. cit. under 74), p. 22.

[82] *Halbwachs, M.:* Morphologie Sociale, Paris, 1938.

[83] *Girard,* op. cit. under 74), ibid.

[84] *Sauvy, A.:* Thèorie Génèrale de la Population, Vol. I—II, Paris, 1952, 3e Ed., ibid. 1963, — *Pressat, R.:* L'Analyse Dèmographique, Methodes, Résultats, Applications, Paris, 1961, — several editions and translations, — *Malecot, G.:* La Génétique de Population, Population, 1955, Nr. 10, pp. 239 and furth., — *Sutter, J.—Tabah, L.:* Les Notions de l'Isolat et de Population Minimum, ibid., 1951, Nr. 6, pp. 481 and furth.

its name for the "more scientific" German term of „Demologie", but without success[85]. *Von Mayr,* however, who first supported these ideas, in 1922, switched to considering Demography as a part of Statistics under the denomination "Bevölkerungsstatistik", and the same may be said of *Franz Žižek,* another central figure in German Statistics[86] while a considerable part of the other German scholars of the same period were still following the traditional economic ways paved by *Roscher,* even if under the increasing influence of modern Anglo-Saxon economic theory. Another interesting revival of the line of thought of *Knapp* and his followers, but with reminiscences of the formation of the "econometric school" in the early thirties was initiated by the Austrian scholar *Wilhelm Winkler* in 1961 in the form of a "Demometrie"[87]. This version of modern Demography ᴀimed to measure population change by mathematical methods and had to provide for appropriate indices, methods and models, but with the help of the empirical and stochastic approach, i.e. in the modern probabilistic sense. The Swedish scholar *Hannes Hyrenius,* in a book published in 1966, attributed the invention of this term to himself and wanted to establish a similar version of modern Demography. In Germany no textbook of Demography in the modern sense was published before *Mackenroth's* "Bevölkerungslehre" in 1953 which is in line with modern demographic development, as well as *von Mohl's* views at the end of this decade[88].

As I have already mentioned, the decisive contributions to the formation of "Pure Demography" were the Anglo-Saxon and especially the American ones on the one hand and also to the development of sociological demographic thinking on the other. A strong demographic school was formed at the London School of Economics following *Kuczynski's* work, and in this context, especially the writings of the professors *Glass* and *Grebenik* should be mentioned together with the demographic teaching at this University, despite the fact that the first modern textbook of Demography was produced by *Cox* in 1950[89] and since it has appeared in more than five editions. In the USA, there was a real "boom" in Demography in the post-war period, and the first impressive textbook of a great size was edited by *Hauser* and *Duncan* in Chicago 1959[90]. Several American scholars contributed to the methodology of Pure Demography in an impressive way, i.e. *Tietze, Whelpton* and *Freedmann* to the problem of the measurement of fertility; *Coale* and *Demény* to the elaboration of model life-tables; *Coale, Hoover* and *Spengler* to Economic Demography[91], even if, in America, this specialized branch of modern demography is still nearer to economic theory than to a demographic "genus proximum". This is clearly shown by its usual denomination of "Population economics" versus the corresponding French term of "Dé-

[85] *Kőrösy, J.:* Wissenschaftliche Stellung und Grenzen der Demologie, Allgemeines Statistisches Archiv, Tübingen, 1892, Vol. II., pp. 397 and furth., — *Rümelin, G.:* Bevölkerungslehre, in Schöbergs Handbuch der Politischen Ökonomie, Bd. 1, p. 828.

[86] *Von Mayr, G.:* Statistik und Gesellschaftslehre, Bd. 2; Bevölkerungsstatistik, Tübingen, 1922, — and *Žek, F.:* Grundriss der Statistik, München und Leipzig, 1921 and 1923.

[87] *Winkler,* op. cit. under 42), — with reference to the priority problem of this denomination and to the work *Hyrenius, H.:* Demometri, Göteborg, 1966, on pp. 11 and furth.

[88] *Mackenroth, G.:* Bevölkerungslehre, Berlin, 1953, — and *von Mohl, R.:* Geschichte und Literatur der Staatswissenschaften, Bd. 3, Heidelberg, 1958, pp. 411 and furth.

[89] *Cox, P. R.:* Demography, Cambridge, 1950, — several editions.

[90] *Hauser, P. M.—Duncan, O. D.:* The Study of Population, Chicago, 1959, — with several coauthors. See esp. *Lorimer, F.:* The Development of Demography, pp. 124 and furth.

[91] *Tietze, Chr.:* Fertility Control, International Encyclopaedia of the Social Sciences, New York, 1968, Vol. 5 pp. 382 and furth. — *Whelpton, P. K.* et al.: Fertility and Family-Planning in the United States, Princeton, 1965, — *Coale, A.,* — *Demény, P.:* Regional Model Life Tables and Stable Populations, Princeton, 1966. — *Spengler, J. J.:* Population Economics, Selected Essays, Durham N. C., 1972, — *Friedmann, R.:* Fertility, Int. Encyl. of the Social Science., Vol. 5, pp. 371 and furth.

mographie économique"[92]. There were, of course, important contributions to this develop-ment from all over the world, which could not be mentioned in this rather rudimentary analysis, — but I want to draw attention to the case of the development in Italy in this context which presents a very specific characteristic from the scientific historic point of view. Notably, similar to the development of economic ideas in this country, the develop-ment of Demography, within the national and linguistic borders, refects also fairly well the world development itself, — without being as closely connected with it as it was with other scientific areas, — a peculiarity which has already perplexed many historians especially of economic and statistical ideas[93].

Conclusions

Let us sum up the main results of this last and decisive period in which Demography became a well-established autonomous science from the point of view of the five criteria serving us as guidelines in our present analysis. As a preliminary remark, one could say, there is a widespread general agreement, at the actual level of scientific development, on all of these five criteria as empiricism prevails over doctrinalism.

Thus, there is general consensus on the object of modern Demography, constituting the first criterion. It is identical with the study of human populations as mass-phenomena, beginning with "pure" or "formal" Demography, considering only population itself as a variable, and continuing with the study of its genetic context in the form of "Population genetics" as a natural, i.e. biological branch of it. By taking into consideration not only natural, but also social variables and their interdependence with the population variable, the ensuing science necessarily becomes an applied science in the form of "Social Demo-graphy" in its own right because of its special aspects, even if its applications form an important part of modern Sociology proper. The interdependence of the various population and economic variables may be incorporated in "Social Demography", but the recent development of a new and specialized branch of "Population Economics" or "Economics of Population" has already been established. The same could be said as regards the historical approach to Demography; "Historical Demography" and "Paleodemography" specialize in the problems of past populations, the "History of demographic ideas" deals with the history of this science, and "Demographic forecasting" considers future population develop-ments with the help of projections into the future on the basis of probability hypotheses, either deterministic or stochastic.

As concerns the second criterion, the methodology of modern Demography is basically built on populations statistics, according to the mass-phenomena character of the human populations studied. Among them, along the "pure" demographic lines, the role of mathe-matical statistics is overwhelming, but there is also a strong influence from mathematical economics and econometry, especially in the treatment, approximation and modelization problems of stochastic processes. Parallel with them, the methods of related natural sciences, e.g. biology, psychology, medicine etc. are currently used, if necessary, and this is equally true of "Social Demography". Here the modern sample survey methods have developed into a major tool of statistical methods, but methods of related social sciences are also applied, e.g. those of economics, history, law, etc., — or a comprehensive combination

[92] *Horváth, R. A.:* A Contribution to the Basic Conceptual Problems of Population Economcs, Demográfia, 1971, Nr. 4, pp. 351 and furth. (Hung. text with English summary).
[93] In economics *Surányi—Unger, Th.:* Die Entwicklung der theoretischen Volkswirtschafts-lehre im ersten Viertel des 20. Jahrhunderts, Jena, 1927, — in statistics *Westergaard,* op. cit under 6), which missed completely this point.

of them. It would be rather difficult to speak of explicit "demographic" methods — besides the problematics of life-tables — since the number of specific "demographic characteristics" is equally small. But their application to the well-defined object of population does not even make it necessary to ascribe such — rather limited — aspirations to modern Demography. The harmony of object and method, two of the basic criteria, may today be considered perfect.

There is also a widespread consensus concerning the denomination of the new science: according to the third criterion, the term "Demography" today enjoys universal acceptance; even in the Anglo-Saxon world, it is defending its place against the term "Population Study", — a sympton of the strengthening of the process of "self-identification" in itself, undisturbed by the already mentioned — rather isolated — attempts to introduce and apply new alternative terms.

And as concerns the crucial fourth criterion, it does not do any more harm to the worldwide recognition of Demography as an autonomous science. The distiction between "pure" and "applied" Demography as its primary object has revealed its inherent multi- or pluri-disciplinary character and demonstrates that any clear-cut choice in this science — either for the natural or the social science concept — was bound to fail during its relatively short, but tempestuous history. Certainly, during the formation process of Demography, scientific development was set back several times by some so-called "scientific analyses of theories" which in reality were only partly scientific and were more or less inspired by, or aimed at population-policy aspirations. If accepted, one is transposing the population problem from the scientific field of investigation to the field of the political theory or political action. These implicit or explicit shifts are, of course, also of essential interest to any scientific history worth its name and are closely connected with our fifth criterion, the institutionalization of modern Demography, where the historian of science has to report an even more remarkable development during this last period than ever before.

When we criticize the rather confused standpoint of *Quetelet* regarding the crucial first and fourth criteria in Demography — already foreshadowed by *Benini* in 1901[94] —, in the context of the fifth criterion the Queteletian heritage comes into its own. We have to think only of the impressive work on demographic statistics done by the national official statistical services, implemented today with the help of international statistical institutions: censuses every five or ten years are the rule all over the world, and the vital statistical registration — at least since the beginning of our century — is a necessity in the majority of countries[95]. The work done in this field by the Queteletian international statistical congresses has yet to be evaluated by scientific historians of Demography, and the same is true concerning the activity of their successor, the International Statistical Institute, as I last emphasized some years ago[96]. I want to mention only one pioneering idea of this Institute: the statistics of the big agglomerations all over the world, launched in the first decade of our century — an idea which has still not been fully exploited despite the increasingly menacing developments happening on our planet. The other idea of an international demographic year-book was realized some decades ago by the United Nations Statistical Office. As I have also hinted, at the turn of the century, a huge number of international demographic bodies were created, e.g. the International Demographic Congress, or the International

[94] *Benini,* op. cit. under 30).

[95] Comp. with *Grebenik, E.:* Vital Statistics, International Statistical Encyclopaedia, Vol. 2, 1225 and furth.

[96] *Horváth, R. A.:* Le Concept de Statistique International et son Evolution Historique eu Egard Particulier à Quetelet, in op. cit. under 29), pp. 67 and furth.

[97] Ibid., p. 81, — with reference to the International Demographic Yearbook of the Permanent Office of the ISI between 1914—18, — and p. 82, with the mentioning of the international bodies of demographic interest created before World War I.