

THE 300TH ANNIVERSARY OF J. GRAUNT'S  
*OBSERVATIONS* (1662)\*

—An essay on its present-day significance—

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I. Introduction

With the turn of 1962, 300 years have passed away since the *Natural and Political Observations made upon the Bills of Mortality* by J. Graunt (1620—74) was published in England in 1662. As is well known, this work has widely been regarded, especially in its close relationship with the Political Arithmetic expounded by Sir W. Petty (1623—87) in the 70's of the 17th century, as one of the fountainheads<sup>1</sup> from which modern statistics originated. It is commonly held that modern statistics has two other sources of no less importance, namely the Staatenkunde initiated by H. Conring (1606—81) in Germany and the theory of probability developed by B. Pascal (1623—62), Ch. Huygens (1629—95), etc. in France and the Netherlands. A particularly noteworthy fact is that these academic achievements were also accomplished in the middle of the 17th century.<sup>2</sup> Thus, it may safely be said that the year 1962 marks also the 300th anniversary of the birth of modern statistics.

These three origins of modern statistics, be it noted, were born and developed not in one and the same but in widely different social environments. Moreover, they have not always been accorded equal weight as the sources of modern statistics even when all three of

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<sup>1</sup> It goes without saying that, as pointed out by a number of research workers, statistical surveys and practices by the governments of modern states must also be regarded as another origin of modern statistics.

<sup>2</sup> Conring started his lecture on "notitia rerumpublicarum" at Academia Julia (Helmstedt University) in 1660. (V. John, *Geschichte der Statistik*. Stuttgart, 1884. p. 68.) Pascal's contribution to the theory of probability was inseparably connected with studies by P. de Fermat (1601—65): their achievements were developed in 1654. Huygens' first work on the same subject was published three years later or in 1657. Cf. I. Todhunter, *A history of the mathematical theory of probability from the time of Pascal to that of Laplace*. Cambridge and London, 1863. p. 7—8, 22.

them were accepted as such.

As will be explained later, some scholars studying the history of statistics would not consider the *Staatenkunde* as an origin of statistics, and others are inclined to disregard the theory of probability. There is no denying the fact, however, that Graunt's *Observations* has long been recognized, ever since the mid-19th century, as a pioneering contribution to the establishment of modern statistics, regardless of what standpoint historians or statisticians might take.

What is attempted here is actually to go beyond this and ask a question: Granted that the *Observations* marks the origin of modern statistics, does its significance lie therein only and nothing more?

The reason why modern statistics has been considered as originating, among others, from the *Observations*, no matter how this science itself might be defined, can easily be found in the fact that in this book Graunt made quantitative observations of social phenomena, clarified the quantitative relations among them and derived some quantitative regularities in their occurrences and sequences. His observations were really the first achievement, in the academic history, on the way toward quantification of social phenomena, and this is no doubt the most salient feature of his work.

In spite of this, the writer cannot help raising the above question after having analyzed carefully the whole contents of Graunt's "natural and political observations", and especially in view of the fact that the *Observations* was actually a joint product with Petty and that it had something important to do with the birth and growth of Petty's Political Arithmetic and the labour theory of value which underlay the latter's whole theoretical structure. The ultimate aim of this paper is to make an inquiry, if not a conclusive one, into this question, and the writer hopes that this will prove a fruitful attempt to reconsider the significance for us of the *Observations* on the occasion of the 300th anniversary of its publication.

With this in mind, the writer proposes first of all briefly to trace the evaluations of the *Observations* for the past ten decades from the middle of the 19th century up to the present and, on the basis of such a historical survey, carefully to analyze and examine the whole contents of the *Observations* and its relations with Petty's Political Arithmetic.

## II. A historical survey of evaluations of the *Observations*

To trace historically the interpretations and evaluations in the past century of the *Observations* is tantamount to making a survey of the history of studies on Graunt and his work.<sup>3</sup> Furthermore, it naturally provides us with a history of statistics itself as Graunt is widely recognized as one of the most influential founders of modern statistics. Almost the same may well be said of any classical work in every field, but in the case of the *Observations* there still remains unsolved one delicate problem, namely the long-pending controversy over the authorship of this work. In a word, the question is: Who really wrote it, Graunt or Petty? Who played an essential role in completing it if it was really their joint work? This problem has been discussed again and again since the middle of the 19th century.

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<sup>3</sup> This is particularly the case because Graunt was really "a writer of one book". Besides the *Observations*, he wrote two or three essays, but almost all of them have been lost.

The authorship dispute actually gives us a side glimpse into history of modern statistics, for to raise the question of which author provided the most essential contribution to the *Observations* implies an issue of greater importance; namely: what is the true essence of this pioneer-work and how should it be evaluated by us? Thus, the writer proposes to summarize in the following the past evaluations of the *Observations* as well as the authorship controversy.<sup>4</sup>

It is from the 30's to the 50's of the 19th century that the *Observations* came to be recognized for the first time as one of the pioneering works in the field of modern statistics, and it can be said that its evaluation by L.A.J. Quetelet (1835, 1846) and C.G.A. Knies (1850) played a key role in this respect.<sup>5</sup> In those decades, be it noted, Quetelet's statistics based upon mechanical materialism and the theory of probability began to bring about far-reaching influence all over the European countries; modern statistics gradually established itself in academic circles; and official statistical surveys were conducted and developed, with a view to confirming the law of large numbers on the basis of organized mass observations, by governments of various countries where industrial capitalism had made notable strides.

Just at that juncture, a controversy in the strict sense of the term first broke out concerning the authorship of the *Observations* as it was initiated by J.R. McCulloch in 1845. It may well be said that the time was ripe, with the establishment and development of modern statistics, for an earnest inquiry into the question of a pioneer of this discipline. Why then did the *Observations* come to be regarded as a fountainhead of modern statistics? This is because Graunt first carried out the quantitative study of social (population) phenomena and derived from them quantitative regularities upon which the law of large numbers was to be built up, although he might have been unaware of such a law. His contribution in this respect was really of great importance. Moreover, Petty's Political Arithmetic was highly appreciated mainly because it applied Graunt's method of research extensively to economic phenomena—i.e. because the development from Graunt to Petty marked the progress from vital statistics to economic statistics. In contrast, the Conring-Achenwall's *Staatenkunde*, "Universitätsstatistik" as it was called, failed to give proper weight to quantitative observations, and thus it came to lose much of its significance as a source of modern statistics. On the other hand, the theory of probability, developed in France, the Netherlands and Belgium, gradually came to occupy the spotlight.

In and after the latter half of the 19th century, particularly after the panic of 1873 about when the capitalist system is said to have advanced into the stage of Imperialism, statistical studies in Europe were featured by the spread of Quetelet's influence; a school of

<sup>4</sup> As for the interpretations of Political Arithmetic, refer to the writer's article "Five periods of study in the history of statistics" (*THE ECONOMIC REVIEW*, Vol. 12, No. 2, April 1961); and concerning the authorship dispute, to his "Historical survey of J. Graunt's *Observations*, its social basis, methods and controversial problems" (*Idem*, Vol. 7, No. 2, April 1956). These two previous papers are summarized in the following.

<sup>5</sup> As for the evaluations of the *Observations* previous to the days of Quetelet, refer to the writer's papers mentioned in the preceding note. It is quite well known that J.P. Süssmilch highly praised Graunt's deduction of the quantitative regularities and compared it to the Columbus' discovery of the American Continent. It must be noted, however, that G. Achenwall, a contemporary of Süssmilch and a founder of the "Universitätsstatistik", interpreted the method of the English Political Arithmetic as "mathematischer Beweis" or "a priori" demonstration. Cf. G. Achenwall, *Die Staatsklugheit nach ihren ersten Grundsätzen entworfen*. 2. Ausg. Göttingen, 1763. Vorrede, §§ 20—24.

“Sozialstatistik” was established in Germany, and so-called “Methodiker” gained ground in England and the United States. And it was in this period that the reference frame for the history of statistical studies was more or less clearly formulated. Taking the initiative in this direction was A.H.G. Wagner who in 1867 completed his history of statistics (in *Deutsches Staats-Wörterbuch*, 10. Bd.) under an extremely strong influence of Quetelet and in compliance with Knies’ evaluation of the Political Arithmetic. In Wagner’s opinion, the Staatenkunde was nothing more than a pre-historic endeavour, as it were, and the course of normal development indigenous to statistics followed the Graunt-Petty-Halley-Süssmilch-Quetelet genealogy. The history of statistics along this line was no doubt a genealogical description of statistical methods written from the standpoint of modern statistics established by Quetelet, but historical thinking of this sort prevailed from the latter half of the 19th century to the World War I among a number of scholars in the field in England, France, Italy and Russia,<sup>6</sup> not to mention the “Sozialstatistiker”<sup>7</sup> of Germany who took the greatest interest in the history of statistics in those days.

It is of great significance that a conclusion compatible with the reference frame, mentioned above, was finally reached as regards the protracted controversy over the authorship of the *Observations* toward the end of the 19th century and thus the dispute appeared to come to an end. The one who gave finishing touches to this conclusion was none other than Professor C.H. Hull, editor of *The Economic Writings of Sir William Petty* (1899). His view may be summarized as follows: 1) Neither Graunt nor Petty was the “exclusive author”, 2) but the “essential and valuable part” was written by Graunt (i.e. the quantitative relations and regularities found by means of the persistent and extremely cautious methods of observation should be credited to him), and, therefore, 3) Graunt was the author of the *Observations* “in every proper sense”.<sup>8</sup>

While studies in the history of statistics were thus being formalized, a school of different strand appeared in those decades, incorporating the history of statistics into that of mathematics, the theory of probability in particular, or even disregarding the history of statistics altogether. Especially conspicuous was the mathematical inclination of A.L. Bowley (1901), G.U. Yule (1911) and other “Methodiker”. This tendency, needless to say, synchronized or coincided with the universal application of mathematical methods to both natural and social sciences.

Studies in the history of statistics during the inter-war years turned out to be quite similar in nature to those in the preceding decades in that emphasis was placed on the methodological development. In this period, the “Sozialstatistiker” in Germany liquidated themselves;<sup>9</sup> i.e. they brought themselves nearer to the camp of the “Methodiker” (the

<sup>6</sup> The authors whose studies in the history of statistics the writer was able to survey are as follows (classified by country): Germany—A.G. Wagner (1867), A. v. Oettingen (1868—73), A. Oncken (1870), M. Haushofer (1872), G.F. Knapp (1874), J.E. Wappäus (1881), V. John (1884), A. Meitzen (1886), W. Lexis (*HdSt.* 1894, 1901, 1911), G. v. Mayr (1895), J. Conrad (1900), and G. Schnapper-Arndt (1908); England—W. Hooper (*Ency. Brit.* 1887, 1911); France—M. Block (1878), and E. Levasseur (1889—92); Italy—A. Gabaglio (1880); Russia—Ю.Э. Янсон (1879), and И. Миклашевский (*Энци. Слов.* 1901).

<sup>7</sup> V. John’s *Geschichte* (1884), which is widely considered as the best historical sketch of statistics, is essentially written along this line.

<sup>8</sup> C.H. Hull, Introduction. p. lii—liii. (*The economic writings of Sir William Petty*. 2 vols. Cambridge, 1899.)

<sup>9</sup> R. Ohashi, *Shakaikagakuteki Tokeishiso no Keifu* (in Japanese, *The genealogy of scientific thoughts in the socio-economic statistics*). Kyoto, 1961, p. 26—41.

mathematical school) in England, the United States, etc. As the mathematical school steadily gained influence, the orthodox school of studies in the history of statistics lost ground and, still worse, the history of statistics itself gradually fell into oblivion. To say the least, an increasing number of scholars came to lose much of their interest in the history of statistics. For all this, however, it is significant that the interest in, and evaluations of, the *Observations* continued unchanged.<sup>10</sup>

Toward the end of 1920's, however, the authorship dispute became hotter than ever due mainly to the publication in 1927 of *The Petty Papers* and in 1928 of *The Petty-Southwell Correspondence* in which "we now see him [Petty] in a new light".<sup>11</sup> Heated discussions were exchanged mostly between the Marquis of Lansdowne, Petty's descendant who edited these books, and Professor M. Greenwood, Honorary Secretary of the Royal Statistical Society. Professor Greenwood supported basically the opinion of Professor Hull, referred to earlier, while on the other hand the Marquis of Lansdowne asserted that the *Observations* was Petty's own work "in 'all essential respects'"<sup>12</sup> on the ground that the essence of this classical publication did consist not in the figures and tables contained in it but in the deductions and observations derived from them. The controversy in this period, however, failed to come to any conclusion. It may be said after all, as Professor S. Kuruma aptly stated it, that the authorship dispute "depends upon the difference of opinions about where in the true value of the *Observations* lies".<sup>13</sup> In one word, it hinges on the divergence of views concerning the nature and significance of modern statistics.

Concerning studies in the history of statistics since the end of the World War II, it is not easy for the writer to give even a summary, much less to make a comprehensive analysis; but on the basis of what little literature he has been able to survey, he may mention the following trends of study and research: namely, 1) In England, the United States and other capitalist countries where the "Methodiker" have been in the majority, research activities have been concentrated upon practical mathematical theories and techniques, sampling in particular, whereas almost no serious attempt has been made in the field of studies in the history of statistics. It goes without saying that this tendency has been closely connected with the ever-widening popularity of modern economics, especially econometrics, which employs mathematical methods as a main tool of research.<sup>14</sup> 2) In West Germany and Austria,

<sup>10</sup> The authors whose studies in the history of statistics the writer was able to survey are as follows (classified by country): Germany—F. Žižek (1921), C. v. Tyszka (1924), F. Zahn (1925), and P. Flaskämper (1944); U.S.A.—H.M. Walker (1929), and W.F. Willcox (*Seligman's Ency.* 1937); Italy—L. Galvani (*Enci. Ital.* 1937); Denmark—H. Westergaard (1932). It is quite natural that in his "Historical Note", Professor R.A. Fisher (1925) made only a cursory sketch of the history of the theory of probability, for he states that "statistics is essentially a branch of applied mathematics". A.W. Flux (*Ency. Brit.* 1929) almost utterly disregarded the history of statistics. Westergaard's book (1932) was exceptional in nature among various works written in this period by the "Methodiker".

<sup>11</sup> L. Hogben (Ed.), *Political Arithmetic, a symposium of population studies*. London, 1938. p. 23.

<sup>12</sup> Marquis of Lansdowne (Ed.), *The Petty Papers*. London, 1927. Vol. II, p. 282. Among various matters brought to light in the course of this dispute, it is most noteworthy that the well-known life table (*Observations*, Chapt. XI), which had long been regarded as having been prepared by Graunt, was credited to Petty as the result of Professor Willcox's inquiries. Cf. M. Greenwood, *Medical statistics from Graunt to Farr*. Cambridge, 1948. p. 38—39.

<sup>13</sup> S. Kuruma, his Japanese translation of the *Observations*. Tokyo, 1941. Explanatory postscript. p. 427.

<sup>14</sup> In his *History of economic analysis* (New York, 1954), though it does not present a history of statistics, Professor J.A. Schumpeter evaluates the *Observations* as "a fountainhead of modern demography" and, interestingly enough, regards Graunt and Petty as pioneers of econometrics. *Ibid.*, p. 209—212.

capitalist countries as they are, the tradition of the "Sozialstatistik" has been preserved, and some scholars have been studying the history of statistics as one of their main subjects. But their methods of research are methodological in nature, and they evaluate the *Observations* as a pioneering work of modern statistics as was the case with their prewar predecessors. It is to be noted, however, that they are adopting such new methods as to connect as closely as possible the progress of statistics with that of other related sciences from the widest possible point of view,<sup>15</sup> and that they are trying hard to grow out of the conventional way of historical thinking.<sup>16</sup> 3) In the Soviet Union, East Germany and other socialist countries, studies in the history of statistics are featured by one characteristic approach: namely, in general the progress of statistics is being studied in close connection with the historical development of society, and in particular Petty's Political Arithmetic in connection with economics.<sup>17</sup> Here, too, the *Observations* is regarded as one of the valuable fountainheads, but the methods of study employed differ widely from those adopted for methodological research in the pre-war times.<sup>18</sup>

The authorship of the *Observations* has not been discussed in earnest since the war's termination. But there have been published some notable works referring to this academic issue. As far as the writer knows, opinion is apparently gaining momentum that this statistical classic is a joint work of Graunt and Petty in the strict sense of the word.<sup>19</sup> Unfortunately, however, the nature and extent of their collaboration, wherein the writer believes one of the masterkeys for proper evaluation of this work really lies, has not yet been studied intensively enough nor clarified to the point of solution.

The foregoing historical summary of various evaluations and interpretations since the middle of the 19th century presents us not so much a conclusion as a continuing query: Does the significance of the *Observations* lie only in its being a forerunner of modern statistics? Let us now turn our attention to what is really contained in it and what significance it can claim for us?

### III. Contents and significance of the *Observations*

The full title of the first edition is as follows:

<sup>15</sup> Cf. C. Lorenz, *Forschungslehre der Sozialstatistik*. Berlin, 1951. Ditto, *Geschichte der Statistik*. (HdSw. 15. L. 1957.)

<sup>16</sup> Cf. F. Klezl-Norberg, *Allgemeine Methodenlehre der Statistik*. 2. Aufl. Wien, 1946. Also P. Flakämper, *Allgemeine Statistik. Grundriss der Statistik*. Teil I. Berlin, 1944.

<sup>17</sup> Cf. М.В. Птуха, *Очерки по истории статистики XVII—XVIII веков*. Москва, 1945. Ditto, *Очерки по истории статистики в СССР*. 2 Том. Москва, 1955, 1959. А. Вострикова, *Статистика*. (Большая Советская Энциклопедия. 2. Изд. Том. 40. Москва, 1957.) E. Herrde u. O. Kuhn, *Grundlagen der Statistik für Wirtschaftler*. Berlin, 1956. O. Lange, *Teoria statystyki, część I*, P.W.G. Warszawa, 1952. (Japanese translation. Tokyo, 1954.)

<sup>18</sup> R. Ohashi, *Gendai Tokeishiso Ron* (in Japanese, *Present-day statistical thoughts*). Tokyo and Kyoto, 1961. It includes suggestive passages on the trend of statistical thoughts in various countries.

<sup>19</sup> Cf. E. Strauss, *Sir William Petty, portrait of a genius*. London, 1954. p. 187—191. H. Hartley (Ed.), *The Royal Society, its origins and founders*. London, 1960. p. 86—87. Academician M.V. Ptucha (М.В. Птуха) sticks to what has been advocated by Professor Hull and by Professor Greenwood. *Op. cit.* (1945), p. 43—45. S. Kühnis, *Die wert- und preistheoretischen Ideen William Pettys* (Winterthur, 1960), also refers to this issue. *Ibid.*, p. 94.

*Natural and Political* / OBSERVATIONS / Mentioned in a following Index, / and made upon the / Bills of Mortality. / By JOHN GRAVNT, / Citizen of / LONDON. / With reference to the *Government, Religion, Trade, / Growth, Ayre, Diseases,* and the several Changes of the / said City. / — *Non, me ut miretur Turba, laboro, / Contentus paucis Lectoribus* — / LONDON, / Printed by *Tho: Roycroft,* for *John Martin, James Allestry,* / and *Tho: Dicus,* at the Sign of the *Bell* in *St. Paul's / Church-yard,* MDCLXII.

Before explaining this lengthy title which eloquently bespeaks the author's personality and the contents of his work, let us see the bare outline of this first edition: it consists of 1) two epistles, one dedicatory to Sir J. Roberts, Lord Privy Seal, and the other to Sir R. Moray, President of the Royal Society, 2) the 106-item "Index" indicating the "Positions, Observations and Questions contained in this Discourse", 3) "The Preface" by the author, 4) main discussions composed of 12 chapters,<sup>20</sup> 5) "The Conclusion", 6) five sorts of "Tables", and 7) "Advertisements for the better understanding of the several Tables". The main text with preface is merely 74-page quarto, or "the whole Pamphlet, not two hours reading"<sup>21</sup> as Graunt himself put it.

As clearly written on the title page, Graunt was born a citizen and a merchant (haberdasher) of London. It is known that in his youth he devoted himself to Socinian doctrine, and that as Puritan he took active part in the Civil War and "served with distinction" as an officer of the "City train bands". It was during this period that he became acquainted with Petty who "had given attention to the collection and examination of statistics".<sup>22</sup> Probably in the days of the Commonwealth, it is surmised, Graunt started a study of mortality bills rather from his own personal interest. First of all, he assiduously collected the Bills of Mortality in the City of London after the end of the 16th century. Then, he classified them by burial, christening, disease and casualty, and rearranged the itemized statistics by sex, season, parish and so forth. This enabled him to prepare several tables. When he examined his own "Conceits, Opinions and Conjectures" on the basis of these tables and further derived "reason and occasion" from these tabular data, he found out some "new ones", namely "some Truths, and not commonly-believed Opinions, to arise from my [Graunt's] Meditations upon these neglected Papers".<sup>23</sup>

The method of research Graunt intentionally employed in this case was none other than the "Mathematiques of Shop-Arithmetique",<sup>24</sup> which was characterized, among others, by the method of proportional estimation. His thinking and practice, there can be no doubt, was encouraged and supported by the Law of Nature (VIII),<sup>25</sup> by the scientific and technical thought key-noting F. Bacon's Natural Philosophy,<sup>26</sup> and by the ideas of labour inseparably

<sup>20</sup> The headings of the 12 chapters are summarized as follows: namely, "Beginning and progress of the Bills of Mortality" for I, "General Observations upon the Casualties" for II, "Particular Casualties" for III, "Plague" for IV, "Other Observations upon the Plague and Casualties" for V, "Sickliness, Healthfulness, and Fruitfulness of Seasons" for VI, "Difference between Burials, and Christnings" for VII, "Difference between the numbers of Males, and Females" for VIII, "Growth of the City" for IX, "Inequality of Parishes" for X, "Number of Inhabitants" for XI, "Country Bills" for XII.

<sup>21</sup> *Observations*. Epistle dedicatory to Sir J. Roberts.

<sup>22</sup> E. Fitzmaurice, *The life of Sir William Petty*. London, 1895. p. 18, 180.

<sup>23</sup> *Observations*. The preface.

<sup>24</sup> *Ibid.*, Epistle dedicatory to Sir R. Moray.

<sup>25</sup> The Roman figures in brackets in what follows denote the numbers of chapters in the *Observations*.

<sup>26</sup> *Observations*. Epistle dedicatory to Sir R. Moray.

connected with Puritanism and enunciated in his words, "Hands being the Father, as Lands are the Mother, and Womb of Wealth" (VIII).

The "new ones" Graunt finally discovered may be divided into two major categories:

(A) The existence of quantitative regularities in the occurrence of social (population) phenomena, including, to mention the most important, 1) the high death rate in infancy (II), 2) the constant ratio between deaths from specified diseases and the total mortality (II), 3) the seasonal variation of mortality (VII), 4) the ratio between births by sex and the total population by sex (VIII), 5) the death rate by age group (Life Table) (XI), and 6) the higher mortality in urban areas (London) than in the country (XII).<sup>27</sup> As mentioned in the preceding section, it has been well clarified and established in the course of historical studies in the past that the discovery of these regularities as natural law was an unprecedented achievement, initiating the later establishment of the law of large numbers. For this very reason, Graunt has long been regarded as one of the founders of modern statistics. But this is not all what he discovered.

(B) Including the quantitative regularities, various observations by Graunt "have fallen out to be both Political, and Natural". "Natural" observations are concerned with "Air, Countries, Seasons, Fruitfulness, Health, Diseases, Longevity, and the proportions between the Sex, and Ages of Mankind"; and "political" ones, "Trade, and Government".<sup>28</sup> For instance, Graunt observed a close correlation between human health and urban life: health greatly depends upon season and air (IV, VI); the pollution of air is much worse in big cities (London), and this in turn is closely related with the greater amount of smoke coming from the rapid increase of "Sea-Coal" consumption (or the development of modern industry) (XII); and this phenomenon, together with the concentration of population in urban areas, is most responsible for the higher mortality in London (IX, XII). Furthermore, he observed the relations between the fluctuations of christenings and political and religious upheavals and struggles (III), the life-and-occupation correlations (II), the problem of death from starvation ("particular casualties") in connection with the relief of the poor and the preservation of "hands" as "father of wealth" (III, VIII), and so on. These observations, which he "happened to make" without any preoccupation (for he "designed them not"), turned out to have the "Doppelnatur",<sup>29</sup> "natural and political". Thus, he put these two epithets to the title, and dedicated his work to the President of the Royal Society because it was "natural" and to the Lord Privy Seal as it was "political".<sup>30</sup> Needless to say, the "political observations" dealt with various socio-economic problems cropping up in the capitalist society of England which was still in its infancy in the days of the Puritan Revolution.

"It may be now asked, to what purpose tends all this laborious buzzing, and groping? To know, 1. The number of the people? 2. How many Males, and Females?....." In other

<sup>27</sup> Academician Ptucha (M.B. Птуча, *op. cit.*, 1945) points out 15 quantitative regularities Graunt discovered in his work. *Ibid.*, p. 33-34.

<sup>28</sup> *Observations*. Epistle dedicatory to Sir R. Moray.

<sup>29</sup> V. John, *op. cit.* p. 171.

<sup>30</sup> *Observations*. Epistle dedicatory to Sir R. Moray. As is well known, upon publication of his work Graunt was formally recommended by King Charles II himself to the membership of the Royal Society, which had just been founded by the Royal Charter in the same year as his work was put forth. T. Sprat, *History of the Royal Society*, ed. by J.I. Cope and H.W. Jones. London, 1959. p. 67. H. Hartley (Ed.), *op. cit.*, p. 1.



words, for what purpose is it necessary for us to make such "natural and political" observations? This is a key question put forth by Graunt in the opening of "The Conclusion"; and he himself replied "more seriously", saying that the ultimate aim was none other than to secure "the Foundation or Elements" of "true Politiques" to "preserve the Subject in Peace and Plenty". In his opinion, such a political foundation can be built up by comprehensive surveys of "the Land and the hands" which are, so to speak, the parents of wealth for any country; namely, a survey of the "intrinsic value" (natural features, fertility in particular) and the "accidental or extrinsic" value (price in particular) of the land on the one hand, and, on the other, a survey of the "hands" by "Sex, Age, Religion, Trade, Rank, or Degree, &c."<sup>31</sup> These surveys undoubtedly constitute an integral part of a program for statistical surveys which any modern state needs carry out before anything else after the Civil Revolution as was the case with the Commonwealth Government of England. Graunt himself, however, initiated the quantitative observation of not both the "land and hands" but only of the latter, and found out some quantitative regularities prevailing in the variations of population (the hands). At the same time, he came to grasp the socio-economic meanings underlying these regularities. Thus, he put forth his proposal for "true Politiques" in "The Conclusion". In one word, his "natural and political observations" crystalized themselves into two basic categories: "the land and the hands"; but he was yet in no position to unify them from a higher point of view.

As may be noted in various studies in the history of statistics since the middle of the 19th century, the relationship between Graunt's quantitative observations of social phenomena and Petty's Political Arithmetic, or the former's development into the latter, has generally been interpreted as an advance of vital statistics into economic statistics. Such may be the case if we consider superficial characteristics like quantitative observation of socio-economic phenomena; but our study of the whole contents of his observations has clearly revealed that Graunt made a longer step than a mere inquiry into vital statistics, and this becomes all the more evident if we consider his achievements as a forerunner of Petty's Political Arithmetic.

Petty's Political Arithmetic, featured by the quantitative observation and the quantifying of all the aspects of human socio-economic activities, was neither like the economic statistics which observe and tabulate various phenomena of capitalist society and clarify mathematically the quantitative relations among these phenomena isolated from the essential features of capitalist society nor like the econometrics which employs only the mathematical techniques. In terms of mathematical technique, it was a simple arithmetic. Having not a few contradictions and shortcomings as an economic theory, it was an analytical science for the capitalist society in its infancy. This was only natural if we take into account that the Political Arithmetic was founded upon the socio-economic ideas characterizing the turbulent era of the Puritan Revolution in England, that its subject of study was "the true state of the People, Land, Stock, Trade, &c."<sup>32</sup> or wealth and resources thereof, that the main method of study it adopted was that of quantitative observations by means of parallels between the Body Natural and the Body Politic embodied in Bacon's Natural Philosophy and the analysis and reasoning based upon these observations, and that it was initiated and es-

<sup>31</sup> *Observations*. The conclusion.

<sup>32</sup> W. Petty, *Political Arithmetick*. London, 1690. p. 117.

tablished as a science mainly on the basis of the labour theory of value.<sup>33</sup> Therefore, it may safely be said that the scientific development from Graunt to Petty was a qualitative jump. If this was the case, the question presents itself: How was such a noteworthy progress accomplished and what course did it take?

To answer this question, we must first of all inquire into how Petty himself formed his economic theories. If this is to be studied in connection with Graunt's *Observations*, we cannot but recall the similarity between Graunt's "land and hands" survey in "The Conclusion", referred to earlier, and the land survey proposed by Petty in Chapter V of *A Treatise of Taxes & Contributions* (published in the same year as Graunt's work was). The similarity is such that the well-known "parallel passages" are one of the most controversial points in the authorship dispute. If not only the word-by-word similarity but social environments in which these two classical works were born are carefully studied, it will become clear that their resemblances originated in the final analysis from the problem of land-ownership, or one of the most ticklish issues confronting England and its newly-acquired "plantation", Ireland, in the days of the Commonwealth, and that they were closely related to Petty's social practice ("Down Survey") which played a key role for the Cromwellian Settlement of Ireland. The ultimate aim of the Down Survey carried out by the Commonwealth Government under the able supervision of Petty was none other than the measurement of all the lands confiscated from the "Irish rebels", and it was cadastral as well as topographical in nature. It was also intended for proper valuation of the confiscated lands (fixing of land prices) and fair distribution of these lands among the English Protestants. Not only that, Petty initiated a population census in Ireland.<sup>34</sup> It is not too much to say that these activities as a whole were the first scientific survey of the "intrinsic and extrinsic" values of the "land and hands" in the world history.<sup>35</sup> This problem was theoretically analyzed and clarified in Chapters IV—V of the *Taxes* by Petty (particularly his theories on land price and rent, or the theory of surplus value, and "natural price", or value) who stuck to the above-mentioned socio-economic ideas then prevailing and attempted to "enlarge"<sup>36</sup> Bacon's methods to the study of the Body Politic. On the other hand, the same issue was tackled from the standpoint of administrative technique in "The Conclusion" of the *Observations* and in Chapter V of the *Taxes*.<sup>37</sup>

<sup>33</sup> It may be in this very sense that K. Marx interpreted Petty's Political Arithmetic as "die erste Form, worin die politische Oekonomie sich als selbständige Wissenschaft abscheidet". K. Marx, *Zur Kritik der politischen Oekonomie*. Berlin, 1951. p. 50. Concerning salient features of Petty's Political Arithmetic, refer to the writer's paper "For appreciation of Political Arithmetic" (*THE ECONOMIC REVIEW*, Vol. 12, No. 1, January 1961).

<sup>34</sup> Cf. S. Pender, *A census of Ireland, circa 1659, with supplementary material from the Poll Money Ordinances (1660—1661)*. Dublin, 1939. p. i—ii.

<sup>35</sup> To say the least, this is true in so far as the history of land survey and cartography is concerned. Y.M. Goblet, *La transformation de la géographie politique de l'Irlande au XVII<sup>e</sup> siècle dans cartes et essais anthropogéographiques de Sir William Petty*. 2 vols. Paris, 1930. Vol. II. p. 346—347. R.V. Tooley, *Maps and map-makers*. London, 1952. p. 93. E. Lynam, *British maps and map-makers*. London, 1947. p. 33.

<sup>36</sup> W. Petty, *Reflections upon some persons and things in Ireland*. Dublin, 1790 p. 7.

<sup>37</sup> Refer to the writer's paper, "Origin and significance of Political Arithmetic" (*THE ANNALS OF THE HITOTSUBASHI ACADEMY*, Vol. 6, No. 1, October 1955). In 1640's or during the Civil War, Petty was an anatomist and mechanical inventor (natural philosopher), and as such he said, "Labor is the simple motions of men in order to comodities, [for] so many houres as hee is naturally able to en-

Petty's labour theory of value has of course several contradictions: for instance, the value of a commodity is duly measured by the amount of labour employed for its production, which in other places it is attributed to "land and labour". Even in the latter case, however, Petty tried hard to find out the "natural Par between land and labour", or social homogeneity between them. In this manner, be it noted, the "Doppelnatur" of Graunt's "natural and political observations" was dissolved, and the double ideas, "land and hands", were elevated to a unitary economic standpoint.<sup>38</sup> As a matter of fact, his main methods for such theoretical formulation were the Baconian analogy between the Body Natural and the Body Politic, the quantitative observations made by Graunt, and the analysis and reasoning based upon them; and the quantification in his Political Arithmetic was one of the most useful tools for reasoning for the formation of theory, i.e. scientific abstraction or "Algorithme of Algebra",<sup>39</sup> as he later called it. It was, needless to say, by means of this method that Graunt's quantitative regularities were gradually developed into Petty's social qualitative laws.

In both Graunt's *Observations* and Petty's Political Arithmetic, there still remain many

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duce the same". (*The Petty Papers*. London, 1927. Vol. I, p. 211.) Such physiological and mechanical concept of labour gradually developed in his thinking into an economic idea through the practices of the Down Survey in particular and through the observation, analysis and "ratiocination" of the newly-born social relations during the Civil Revolution in general. In his *Studies in the labour theory of value* (London, 1956), Dr. R.L. Meek attributes the formation of this theory in the 17th century to the division of labour, and he refers to Petty's economic writings after the Restoration. (*Ibid.*, p. 37, 39.) It must be noted, however, that Petty discussed the division of labour much earlier than the Restoration or when he defined labour as "the simple motions of men" not from the economic but from "mechanical" point of view.

<sup>38</sup> G. King, a contemporary of Graunt and Petty, also published the *Natural and Political Observations upon the State and Condition of England* (1696), or more than three decades later than Graunt's work. But his "natural and political observations" were confined to the land area, prices of land and commodity, population by "ranks, degrees, titles and qualifications", etc. There can be no doubt that King's "Scheme" still claims historical significance, but it has no unitary idea, unlike Petty's whole theoretical structure, from the socio-economic point of view.

<sup>39</sup> In a letter addressed to Southwell (dated 3 November, 1687), about six weeks before Petty's death, he wrote:

"You have asked me once or twice what Algebra was. I answered that it was a kind of Logick, and a more refined way of reason upon common and easy principles, by adding and subtracting not onely numbers but the several species of things. Also I might have added that the art of adding, subtracting, multiplying and dividing of species, with their rootes, powers and proportions, is called the Algorithme of Algebra....."

"It [algebra] came out of Arabia by the Moores into Spaine and from thence hither, and W[illiam] P[etty] hath applied it to other then purely mathematical matters, viz: to policy by the name of *Political Arithmetick*, by reducing many termes of matter to termes of number, weight, and measure, in order to be handled Mathematically". (*The Petty-Southwell Correspondence*. London, 1928. p. 318, 322.)

At first glance, this appears to be a pioneering idea underlying the symbolic logic vigorously expanded since the latter half of the 19th century. As may be noted in the foregoing, however, there can be no doubt that Petty's "Algorithme of Algebra", which "he might (and perhaps should) have called Political 'Algebra'" (Marquis of Landsdowne, *The Petty Papers*. Vol. II, p. 4), widely differs in nature from the symbolic logic. As was properly stated by Mr. E. Strauss, Petty's "conception of mathematics was, therefore, that of a tool of mental analysis". (E. Stauss, *op. cit.*, p. 184.) It was by means of this method that he grasped the concept of the "social average".

things to be discussed more fully,<sup>40</sup> but the above discussion may suffice to suggest that the *Observations* can claim to be more than a pioneering work of modern statistics. Interpreting the whole contents of *Novum Organum* I, Professor B. Farrington writes: "It may safely be said that the modern development of the social sciences has proceeded on Baconian lines".<sup>41</sup> A typical course of such progress is really seen in the whole contents of the *Observations* as well. Considered in connection with Petty's achievements, Graunt's work undoubtedly paved the way for social sciences, the Political Arithmetic in particular as an anatomy for capitalist society in its infancy, and it may well be said to have been created jointly by Graunt and Petty. In a word, both the *Observations* and the *Taxes* which enunciated the labour theory of value for the first time in history were born from Civil Revolution in England. It is not at all accidental that this year falls on the 300th anniversary of both of these publications simultaneous with the founding of the Royal Society.

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<sup>40</sup> Of special importance is the comparison between Graunt-Petty's Political Arithmetic and Conring's *Staatenkunde*. Mr. R. Zehrfeld's monograph is highly suggestive in this connection. Cf. R. Zehrfeld, *Hermann Conrings (1606—1681) Staatenkunde. Ihre Bedeutung für die Geschichte der Statistik unter besonderer Berücksichtigung der Conringschen Bevölkerungslehre*. Berlin und Leipzig, 1926. p. 62—64.

<sup>41</sup> B. Farrington, *Francis Bacon, philosopher of industrial science*. London, 1951. p. 113.