WILEY

The Method of Statistical Analysis

Author(s): Wynnard Hooper

Source: *Journal of the Statistical Society of London*, Vol. 44, No. 1 (Mar., 1881), pp. 31-49

Published by: Wiley for the Royal Statistical Society

Stable URL: <http://www.jstor.org/stable/2339105>

Accessed: 27-06-2016 03:03 UTC

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at

<http://about.jstor.org/terms>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Royal Statistical Society, Wiley are collaborating with JSTOR to digitize, preserve and extend access to *Journal of the Statistical Society of London*

*The METHOD of STATISTICAL ANALYSIS.**By* WYNNARD HOOPER, B.A.

[Read before the Statistical Society, 18th January, 1881.]

THE theory of statistics has of late years been made the subject of much study on the continent, and a great deal of ability has been applied to solving the problems connected with this branch of scientific inquiry. I am not now referring to the practical statistical investigation of physical or sociological facts, but to speculations as to the nature of statistics, to the theory as opposed to the practice of statistical investigations. In this field the Germans have, as might be expected, taken a prominent position; but France and Italy have contributed their share to the literature of the subject. The latter country, indeed, has produced what is perhaps the best and most comprehensive work on statistics that has yet appeared, namely, Dr. Gabaglio's treatise. England, I regret to say, has been almost unrepresented in this field. The reason for her inactivity is, perhaps traceable in the views expressed at the Dublin meeting of the British Association in 1878 by Professor Ingram in his opening address to Section F. Professor Ingram's able paper was chiefly directed against the so-called "orthodox" school of economists, and he urged the necessity for abandoning the attempt to treat economic questions apart from other aspects of the sociological problem. He went on to say at the close of the paper, in reference to the claim put in for statistics to be recognised as a science, "It is plain that though statistics may be combined with sociology in the title of Section F, the two cannot occupy a co-ordinate position. For it is impossible to vindicate for statistics the character of a science; they constitute only one of the aids or adminicula of science." Now this is the view generally held, I think, in England, and it seems to me to be the right one. But the writers of the continental school hold a different opinion. They maintain that there is a *science* of statistics, and several most able books have been written in France, Germany, and Italy, to maintain this view. They lay it down that statistics is both a method and a science: a method in so far as it is applied, or may be applied, to almost all sciences; and a science in so far as it deals with the phenomena of human society. I shall endeavour to show that the latter part of this thesis is indefensible, but that there *is* a science of statistics in one sense, though the field it covers is a very restricted one.

The conception of the continental school, though partially incorrect, has nevertheless been a fruitful one. To it we owe the valuable works I have just alluded to, in which we find a systematic treatment of the problems of statistical inquiry such as hitherto has not appeared in the English language. On the continent an over-estimate of the importance, and a mistake as to the functions of statistics, has led to a thorough investigation of the statistical method. On the other hand, in England, while we have avoided the mistakes of our foreign co-workers, we have done little either to aid in the work they have successfully performed, or to rectify their errors. Indeed it is hardly too much to say, that, outside this Society, little is known of the writings of the continental authors, and that the need for systematic investigation of the theory of the statistical method is hardly realised at all.

Even as regards the Society, I have observed, in looking over our *Journal*, that the work it has done has been chiefly in the domain of the concrete. The number of papers on the abstract side of statistics, of the study which the Society is especially concerned with, is very small. At intervals of years we now and again meet with a monograph on some point connected with the method of statistics. Among the ablest of these I may mention that read by Dr. W. A. Guy, in December, 1865, "On the Original and Acquired 'Meaning of the Term 'Statistics,' &c." In this valuable contribution to the subject, Dr. Guy anticipates much of the speculations of the continental writers whose works have recently appeared. It is much to be regretted that a more exhaustive treatment of the question has not proceeded from the author of the above paper, whose knowledge of the method of scientific research and practical acquaintance with statistical investigation would have enabled him to perform the task with great success. Incursions into the realm of theory such as this of Dr. Guy are, however, rare. Indeed, it is remarkable that though in the practical business of conducting statistical investigations, and in the application of the results of those investigations to the solution of the problems presented by politics and other branches of practical social science, Englishmen are at least as advanced as foreigners, in almost all that concerns the theory of the subject, they are, comparatively speaking, "nowhere." I know of no work in English in any way similar to those of Dr. Georg Mayr, M. Maurice Block, or Dr. Antonio Gabaglio, to name the three best authorities on the subject; and there are several other writers, such as Dr. Ernst Engel, and M. Haushofer, of whom also it may be said that they certainly try to do what has not as yet been attempted in England, namely, to attain to a scientific conception of the scope of statistics.

The three writers whom I have named are all agreed on the

main points of the inquiry. They all distinguish between the method and the science of statistics. The Method, according to these theorists, is a mode of scientific procedure based on the observation of aggregates of individual phenomena. It is applicable to the phenomena of all sciences; but there is one set of phenomena to which it is especially applicable, namely, those of society. The employment of statistics in sociological investigations gives rise in their view to the Statistical Science. Accordingly we find in the works of these three writers (Mayr, Block, and Gabaglio) a constant reference to the twofold sense in which the term *statistics* is to be understood. I may here remark on the advantages of German, French, and Italian writers in not having to employ such a clumsy plural form as the word in use among us to designate this very important branch of knowledge. They are fortunate in having adopted the singular form (German, *statistik*; French, *statistique*; Italian, *statistica*).

Mayr and Gabaglio employ the same metaphor in describing the distinction. They both speak of "statistics in the wide sense," *i.e.*, the method, and "statistics in the narrow sense," *i.e.*, the science. The other two German authors whom I have mentioned use similar language. I am only acquainted with them at second hand through the medium of the *apparatus criticus* supplied by Dr. Gabaglio in his work on statistics. In order to make good my assertion respecting the substantial agreement of the leading continental writers on this point, I shall quote passages, when possible at first hand, from the works of Mayr, Engel, Haushofer, Block, and Gabaglio; after which I shall offer some remarks on the views they express, and shall endeavour to show that there are grounds for modifying them in some particulars, and that there is room, if I may so speak, for an Anglo-German, as well as a German-Italian school of statistical theory.

The first of the three leading continental writers who have entered profoundly into the subject of statistics is Dr. Georg Mayr, late director of the Bavarian Statistical Bureau, and now occupying a high administrative position in the provinces of Elsass and Lothringen. His work, of which a copy is in our library, is called "*Die Gesetzmässigkeit im Gesellschaftsleben*," which may be translated, "Conformity to Law in Social Life." Mayr's conception of the nature of "*Die Statistik*" is set forth in the following passage (pp. 13 and 14):—"While the statistical or numerical method " holds sway, wherever there occurs a quantitative determination and " co-ordination of facts, based on observation of aggregates, the field " of the science of statistics is restricted to the quantitative investi- " gation of the social life of man, which is only attainable by means " of the observation of aggregates. Accordingly, I define the sta-

"tistical science as the systematic statement and explanation of actual facts, and of the laws of man's social life that may be deduced from these on the basis of the quantitative observation of aggregates." Mayr having thus claimed for *Die Statistik* the right to be considered an independent science, proceeds to justify that claim. He admits that "it may surprise us that the quantitative observation of social aggregates should constitute an independent department of knowledge, while the same claim is not recognised in the case of the observation of purely physical aggregates." Why, it may be asked, should we in one group of aggregate observations speak of an independent science, in another merely of a method? Dr. Mayr then proceeds to give reasons for his own view, which are, to my mind, very inconclusive. These reasons are briefly that the physical sciences only occasionally make use of "aggregate observation," while the social sciences can make use of no other method of inquiry. I shall have something to say on this point later.

The next writer whose views I propose to examine is M. Maurice Block, whose "*Traité Théorique et Pratique de Statistique*" is probably known to members of this Society. M. Block's work is divided into four parts, dealing respectively with the History of Statistics, the Theory of Statistics, the Practice of Statistics, and the Results of Statistics as applied to Sociology (*Partie appliquée, ou Démographie*). With regard to the last, it must be remembered that M. Block considers "Applied Statistics" as "Statistics" *par excellence*, and that, consequently, he does not mention Sociology in connection with it, the connection being understood, being, in fact, a part of his definition of statistics. The following passage, taken from the commencement of the "*Partie Théorique*" ("*Traité*," pp. 85 and 86), expresses his views on the nature of statistics. "*La Statistique** may be regarded as a science, and as a method: as a science, it aims at expounding the political, economical, and social condition of a nation, or, generally, of a group of population; from this point of view, then, the name 'Demography' has been assigned to it. In order that this exposition may possess a scientific value, it should be the result of direct observations, and the facts must have been collected with care, and, above all, with precision; they must have been counted, weighed, and measured. This precision is manifested in the employment of figures, of 'numerical terms.'"

"*La Statistique*, then, has its modes of procedure; it has a special method of observation, which consists: 1. In the employment of numbers; 2. In grouping them with the object of extricating

* I have thought it better to avoid the use of the term "statistics" where it might be ambiguous.

“the facts which are (relatively) permanent, that is to say, of abstracting them from facts which are accidental; 3. In the comparison of permanent facts and of accidental facts, in different places and in different circumstances; and evidently, also, 4. In the employment of the *data* collected and mathematically elaborated for the purpose of more or less direct inductions and deductions.

“This method, which is peculiar to *La Statistique*, is able to render to other sciences services too great for them to neglect. They are often obliged to observe with the logic and rigour of *La Statistique*—at least, with the rigour which *La Statistique* ought always to have, which it already has in several of its branches, and which it will one day have, we may hope, in all. That is why we say that *La Statistique* is also a method. . . . It is not difficult, it seems to us, to distinguish the statistical science from the method which bears its name. When, in a demographical investigation (*dans une démographie*), we make known the causes of the deaths, *La Statistique* performs its functions as the science of population, and not as medical statistics (*statistique médicale*); when a doctor determines the effects of typhoid fever on men and women at various ages, when he compares the number of cures or failures obtained under such and such a treatment in a definite number of cases, he applies the procedures of *La Statistique* to medical science; he employs *La Statistique* as a method.”

This statement of the matter is sufficiently explicit, and, as I shall presently show, it is substantially the same as that of Gabaglio; the agreement with Mayr is obvious.

The next author is Dr. Antonio Gabaglio, whose “*Storia e Teoria Generale della Statistica*” is the latest work published on the subject, having appeared last spring. In several respects it is superior to those of Dr. Mayr and M. Block. Dr. Gabaglio is one of the professors in the University of Pavia, and a copy of his book is in the library of the Society. Dr. Gabaglio distinguishes between the *Science* and the *Method* of statistics, and the definition he gives of the science is very similar to that of Mayr as well as to that of another writer, Haushofer, whose work I have not read, but who seems, to judge from the passages quoted by Gabaglio, to have a very sound conception of the so-called science, and of its relation to the method. One most valuable feature of Dr. Gabaglio’s book is the careful collation of the opinions of the chief statistical writers on the nature of their subject. Before giving Gabaglio’s own views, I shall quote from it those passages which set forth the views of Haushofer, and also of Engel, the chief of the Prussian Statistical Office.

To take Engel first. Gabaglio's statement of his views is as follows :—*

" Engel sees in Statistik a Method and a Science. As a Method " it is Systematic Observation by means of Masses of Facts, and, " as such, it offers itself for the service of the natural sciences as " well. The use of this method consists in mechanical operations " such as the observation of facts, the recording, classification, and " grouping of these observations; and in operations of criticism, " such as the Interpretation of the observations, their comparison " with reference to time and space, and the search for causes and " laws of the phenomena. As a science, Statistik observes the " life of peoples and States in their various aspects and manifesta- " tions; it studies these arithmetically and demonstrates by analysis " their causal relation. In restricting Statistik considered as a " Science to the relations of human life, he does not mean that it " ought to neglect the physical element, the study of which he con- " siders necessary to the exposition of the physiology of population. " Neither does he exclude from Statistik the description of the " condition of human society; nor, further, does he confine Statistik " to a given moment of time, ' It ought,' he says, ' to consider social " 'conditions in their progressive periodic development.' He makes " use of numbers, but admits that 'very few moral relations have " 'as yet been made capable of numerical treatment and translated " 'into figures.' He holds that each phenomenon ought to be known " in itself and in its various parts, and, further, that we ought to " search for the connection in which each of them is found with the " rest; finally, that we ought to *measure* this connection of de- " pendence."

From this brief account of Engel's view of statistics, it will be seen that his point of view is the same as that of Mayr.

Of Haushofer Dr. Gabaglio speaks as follows (p. 177) :—
" Haushofer distinguishes in Statistik between the method and the " science. As a method it investigates conditions and events by " means of mass-observation (*Massenbeobachtung*). It is thus " applied to all phenomena, human and physical, which reveal them- " selves as produced by constant and variable causes simultaneously. " The phenomena observed must be reduced to quantity, " and therefore expressed in numbers, for which, when not avail- " able, it is often possible to substitute approximate expressions of " quantity. The original numbers must further be reduced by " reference to a single unit and displayed in well " constructed tables. The relation between one " phenomenon considered as an effect and one or more other " phenomena considered as its causes are called the *laws* of this

* Gabaglio, p. 144.

“phenomenon. These laws depict the uniformity with which the effects are products of the causes. Consequently statistical law is the shortest expression for the constant relation of dependence between effects and causes. While the ‘natural’ laws hold in single cases, statistical laws only hold in the case of large numbers, which show a certain regularity which is hidden when the numbers are small. The law of large numbers has its origin in the diversity of the causes which produce the phenomena it governs. These causes are more or less variable. Statistik then must reveal the constant cause by reducing it to law, and little by little rendering the variable causes constant. By ‘cause’ is not meant here the final or original cause, but the proximate cause. [It is not quite clear what is meant by ‘rendering the variable cause constant’ (*rendere costanti le cause mutabili*), but the general drift of the passage is obvious enough.]

“As a science, *Statistik* is the Science of Aggregate, especially of the aggregate of human phenomena and of the State, of its movement and its laws. It has unity of method, and also a certain unity of subject matter—namely, the phenomena of human beings in society, and of the State. *Statistik* is an auxiliary science, in so far as it seeks to observe truths which may be the starting point of other sciences. The *Statistik* of Conring and Achenwall, and the *Statistique* of Quételet, can be considered neither as parts of some higher science, nor as two branches of science independent of one another; nor, again, the one as an independent science, and the other as a method. They may be considered as the two opposite currents of one single science, the first with an independent existence not as a science, but as an organised system of useful knowledge such as Statistik, Politic, Political Economy, Political Geography, Ethnography, History, Public Law, &c.”

Assuming that the above *résumé* of the views of Haushofer accurately portrays them, it would appear that the conception of the theory of Statistics adopted by this writer differs somewhat from that of Engel and Mayr, and, as will presently be shown, from that of Gabaglio. The point to which I would call attention is the statement granting to Statistik the claim to be an “auxiliary science” only, a science which “seeks to observe truths which may be the starting point of other sciences.” This view appears to me to be sounder than those of the other writers, but is not fully in harmony with that which I should wish to see generally adopted. It remains to close this examination of authorities by giving the doctrines of Gabaglio. He commences by discussing the various more or less sound definitions given by others, and criticises them, specifying their particular defects, under the heads of vagueness, undue length,

and want of clearness as regards either the science or the method. He then proceeds as follows (p. 239):—" *La Statistica* may be "interpreted in an extended and in a restricted sense. In the "former sense it is a Method, in the latter a Science. As a Science "it studies the actual social-political order by means of mathe- "matical induction." This is Gabaglio's definition, and it is perhaps the best of those which regard Statistics as, in one sense, a science. He explains carefully what he means by the words he has chosen, the most noteworthy point in this explanation being his remarks on the term which I have translated "actual," "*di fatto*." He says: "I mean by *di fatto* that *Statistica* studies the social-political order "not as it ought to be, but as it really manifests itself; that it does "not seek for the primary, absolute, unchangeable causes and laws "of social and political phenomena, but only the empirical and "variable causes derived from them." From this it is clear that Gabaglio has a very clear perception of the limits of statistical inquiry, and that he is well aware of the great need for caution in drawing wide deductions from the results of the method as applied to sociology.

These then are the views and doctrines of the best continental writers on Statistics. They may be summed up thus:—

"Statistics" is a term that is to be interpreted in two senses. It is a method of scientific inquiry (and as such applicable to *all* sciences), and it is also a science dealing with the social life of man. Considered as a science it is a branch of Sociology, which can only be studied by means of the Statistical Method.

Here then we have a claim made that the special department of knowledge which may be termed sociological statistics should be regarded as an independent science, on the ground that there is only one instrument that is applicable to the various phenomena included in it. The claim is endorsed by the three writers who may be regarded as the chief leaders of speculation in this field in Germany, Italy, and France. At the risk of repeating a portion of what I have already said, I shall once more refer to Mayr's views, which I have already described in their general scope. Mayr wishes to distinguish what he conceives to be the *Science* of Statistics, from the *Method*, by departing from the accepted nomenclature. He says,* "It does not at all contribute to the clearness "of our insight into the nature of Statistics, that Statistics and the "Statistical Method should be spoken of in so vague a way. Hence "it has with reason been proposed to speak in such cases as the "above, not of the statistical, but of the numerical method." The cases to which Dr. Mayr alludes are the various applications of the method to the physical sciences. He explicitly objects to

* Mayr, "Die Gesetzmässigkeit," &c., p. 13.

these being included under the head of examples of the statistical method. "The observation of purely physical facts, which "have no connection with the social life of men, is excluded from "the field of the independent science of statistics." And further, he defines this independent statistical science as "the systematic "statement and explanation of actual events, and of the laws of "man's social life that may be deduced from these, on the basis of "the Quantitative Observation of Aggregates."* This definition, when carefully looked into, agrees substantially with the far more concise statement of M. Maurice Block. This able writer has a great advantage over Dr. Mayr, in having French and not German for his native tongue. The former language is admirably, the latter indifferently, well adapted to the expression of intellectual conceptions. M. Block adopts for the independent science of statistics the term *Demography*, and *Demography* is "la science de l'homme "vivant en société, en tant qu'elle peut être exprimée par les "chiffres." "The science of man in the social state in so far as it "can be expressed by figures."†

These statements of Mayr and Block are explicit enough, and show clearly what is the view accepted by them in regard to the nature of statistics. The conception of Gabaglio is equally well defined, and is open to the same objections as that of the other two authorities. In his chapter on "The Limits of *Statistica*" ("Storia," &c., pp. 246-47), he says:—

"*Statistica* being at once a social and a political science, has a "natural affinity, and a community of object with all the other "social and political sciences. This does not imply that it can, or "ought to be confounded with one or other of them, by being made "to overpass its own special limits. It differs from these two "groups of sciences [the one group includes 'Social Physiology,' " 'Economics,' and 'Social Psychology;' the other 'Constitutional " 'Science,' and 'Administration'];"

(1) In being of a twofold nature, having for its subject both *Society* and the *State*.

(2) By the extent of its field, in that it is not occupied merely with this or that social or political fact, but with *all* social and political facts at once.

(3) By the unity and the special character of its function, "it "being restricted, as has been already said, to the research after the "actual causes and laws of social and political phenomena, con- "sidered statically and dynamically." Gabaglio goes on to say, "it does not indicate the original, immutable, absolute, causes and "laws of these facts, but those causes and laws which are purely "empirical and external. The *causes* involve a certain actual

* Mayr, "Die Gesetzmässigkeit," &c., p. 14.

† Block, "Traité," &c., p. 398.

“dependence, and nothing more; the laws express actual uniformities or regularities of a simple kind. These causes and laws are, in short, derivative, or secondary laws, which are, moreover, variable (yet with a kind of regularity), and of a constancy which is purely relative and limited.” He then proceeds to instance one of these “statistical laws,” namely the “law” of the proportion of the births and deaths of the two sexes, and says that these “are not ‘laws’ in the rigorous sense of the word, but in the special statistical signification.”

The three leading authorities on Statistics, then, agree in asserting that though the Statistical Method is employed in the physical sciences as well as in Sociological investigations, the most important field for its employment constitutes a Statistical Science in itself. They therefore claim for “Statistics,” or, as M. Block calls it, Demography, an independent position as a science, in virtue of the fact that the phenomena it deals with can only be investigated by means of the Statistical Method; whereas, in other sciences the latter only plays a subordinate part. With all deference to these three eminent authorities, I cannot admit that this claim is admissible.

The matter, if looked at without any preconceived notions of what is called “vindicating the dignity” of Statistics, is a simple one. Of what kind are the phenomena which “Statistics,” or Demography, investigate? They are social phenomena, and on the face of it, social phenomena constitute the subject matter of Sociology. There is no philosophical reason why Statistics should be considered as a method when applied to physics, and as a science when applied to Sociology. Those social phenomena which we are able to investigate statistically are of a very heterogeneous character. Their investigation has not been undertaken with a view to the obtaining of an organised body of truth, but is the consequence of a great number of desultory inquiries commenced for particular political purposes, and very often subsequently abandoned. Even when they have not been abandoned, the form of the inquiry has frequently had to be changed in consequence of want of thought in the arrangements made at the beginning, thus rendering the later noncomparable with the earlier results. At the present day, indeed, it is possible in the cases of one or two civilised communities to present a fairly adequate view of many of the more important, or at least the most conspicuous, social phenomena. But the collection and arrangement of the facts has been made from all manner of motives. Some of our statistics have been procured from reasons of fiscal policy, some for police purposes, some for legislative purposes some to satisfy the caprices of would-be legislators. Some again have arisen, as it were, unbidden, out of

the ordinary administrative reports of large public departments. There is no bond of union common to them, except that they are sociological facts, and are obtained by the statistical method. But again, to erect the study of the fortuitous concourse of social facts obtained by the statistical method, into a separate science, is erroneous on another ground. Sociology is already naturally divided into several sub-sciences, dealing with special classes of social phenomena, the best organised and best understood of which sub-sciences is Economics. Now the statistical method is employed in all of these, and to make the fact of its employment the differentia of a special science, is to introduce an exceedingly inconvenient and confusing cross-division.

At present, owing to the limited extent of our statistical information regarding even the most highly civilised countries, those who study statistics at all, can without very much difficulty make themselves acquainted with all the more important facts regarding a country which can be rendered perceptible by statistics. But since our means of observation increase as the amount of statistical information grows in bulk, it will before long become wholly impossible for any one man to deal with all branches of sociology at once, and sociologists will become divided into various more or less well-defined groups, the members of each of which will confine their attention to special sections of the science. This is what has occurred in each of the other sciences as they have slowly increased in extent, and the fact that it is still possible for those who study sociology on the statistical method to be, so to speak, encyclopædists as regards it, is tolerably good evidence that sociology is still in a very rudimentary state. The mental work of the world, as well as its physical work, is now carried on to a greater and greater extent in accordance with the principle of division of labour, and the vast magnitude and bewildering complexity of the phenomena presented by the social organism make it peculiarly necessary that they should be as much as possible subdivided for the purposes of science. This subdivision is in fact essential to the adequate treatment of the phenomena of society. I do not mean that a proper conception of the nature and working of such a community as the England of the present day can be obtained by studying separately the phenomena of the growth of population, of the growth of means of communication, of economics, or any other of the conceivable branches into which it might be convenient to divide the great mass of interlaced and interacting phenomena which we denominate the English community. It is one of the peculiar difficulties of sociology that the investigation of each set of facts must proceed simultaneously with that of all the rest if any real result is to be arrived at. To use the hackneyed illustration from physiology, it is no use assuming

that the action of the heart can be considered independently of that of the lungs or the digestive apparatus. We must contrive to trace the consequences of the reciprocal action of all on each, and obtain a conception of the result of their joint action as a whole.

Nevertheless there is one preliminary step which must be taken before we can begin our study of the actions and reactions of the various organs of a living animal or of a community among themselves. We must see what the phenomena are. We must begin by seeing that the heart beats; that the way in which it beats varies at different times, and generally we must become thoroughly acquainted with what for the sake of brevity we may call its "action," before we endeavour to ascertain how that action is caused, how it is affected by the influence of the other organs, and how again it affects the action of these latter. Now, in the case of the heart, all these operations are comparatively easy. We can see, handle, and weigh the heart, we can count its pulsations, and generally observe a good deal of what we require to know by judiciously contrived experiments; and the same is true of the other organs of animals; but when we come to the organs of a community—of a highly organised community I mean—the case is very different. In the first place the mere magnitude of the phenomena, their mere extension in space, is a serious obstacle to our appreciating their action properly, even when the particular phenomenon observed is itself localised: and by far the most important phenomena of society are *not* localised. One of the peculiarities of the social organism, in which it differs fundamentally from animal organisms, is the fact that the component parts of its organs are not always in juxtaposition; that the "body politic," as it is often called, has organs which could not under any conceivable condition of things be perceived by the eye. There are, for instance, scattered over England in small groups a number of individuals engaged in what is called the "corn trade," people on whose action depends to a large extent the question whether at a given time corn shall or shall not be imported. The action of these groups to a large extent regulates the supply of corn to the community at large. How their action is determined does not for the moment concern us. The noteworthy point is that the action of the machinery by which this important function is performed is to a large extent imperceptible to an observer unaided by figures. Take any great market, or rather any great "trading body," to employ the useful phrase of Professor Jevons, and consider how little we can know of its functions in the social organism unless we have some quantitative conception of its magnitude and of the effects it produces. Another cause of the difficulties of sociologists is the fact that every individual in a community is a component of many different "organs" at once,

and that the components of the organs are in many cases interchangeable. Mere inspection of the social organism, even such inspection as we might imagine a being of superhuman faculties to make, would reveal almost none of the marvellous phenomena presented by commerce, to say nothing of other less conspicuous matters. Conceive for a moment, as a mere fantastic effort of the imagination, of a being endowed with superhuman faculties of the same order as our own, suppose him supplied with the five senses, but with those senses greatly exceeding ours in efficiency and range of observation, and then suppose him to set himself to investigate the proceedings of man, as we investigate the proceedings of ants in and about an ant-hill. The first thing he would probably notice would be the streams of ships that are continually flowing in and out of London, Liverpool, and other large ports. He would, no doubt, perceive that these streams were larger at some times than at others, and that they diverged in several directions from the port; but it would be impossible for him to discover that the whole movement was the resultant of a great number of single forces, that the ships, in short, were owned by and moved by the wills of a great number of individuals. His inspection of the intricate network of railways and canals would probably lead him to the conclusion that the individuals composing the English people rushed hither and thither in the interior of their tract of land with as great an apparent absence of aim as ants when disturbed in their dwelling. To him all, or nearly all, would appear confusion, simply because many portions of the social organism which really act in the closest concert, which are in actual fact the components of a single force, are widely separated in space from one another.

What I have been saying goes to show that our knowledge of the organic arrangements of a community is at present very imperfect. This is another way of asserting that Sociology, or that branch of it which we may call Social Physiology, is in its infancy. The very conception of society as an organism is present to the minds of only a few. It could not be otherwise, seeing that the instrument of research which will eventually enable Social Physiology to become a well-established branch of human knowledge has only come into existence very recently. The Statistical Method is barely fifty years old, and the materials for its application are neither sufficiently extensive, nor, in many cases, of the right kind. Those who employ the method had for many years to take what they could get, and be thankful they got anything at all. Matters are improving now, I admit, but we are a very long way from an ideal state of things. The choice regarding the social facts which shall be observed statistically is partly dictated by the necessities of government, which

are by no means identical with the necessities of sociological inquiry, and partly by the needs, and often the whims of politicians, which also are not exactly inspired by a love for the interests of science. Lastly, everybody who tries to obtain statistics has to fight against the unconquerable aversion of men to answer questions about what they, not unnaturally, regard as their private affairs. This is an obstacle to the advancement of those parts of Sociology which depend on statistics for their subject matter, that will, we may hope, be eventually remedied by the spread of education.

I shall now give as briefly as possible what I regard as the correct view of the nature of Statistics. It differs from that of the continental theorists in this: While I agree with them that the Statistical Method is the only method available in some portions of sociology, I fail to see that there is anything gained by grouping together the various branches of sociology which deal with them and terming them the "Science of Statistics." Call this branch of knowledge Demography, or, with Dr. Cossa, Demology, if you will; the name is as good as any other, but I do not see that anything is gained by doing so. M. Block's definition, already alluded to, admirably describes Demography as the science of human society in so far as it can be dealt with by figures. Let us keep the term "statistical" to its strict signification, namely, "of or belonging to" statistics; statistics having in this country, at any rate, a well understood concrete signification. We all know what we mean by "statistics of pig iron," "statistics of coffee," "population statistics," or "revenue statistics." We mean actual concrete figures relating to a particular set of phenomena. Even that very objectionable phrase the "statistical position" of a commodity is comprehensible enough, and is in harmony with this use of the word "statistics." It would appear then, that before we can define the meaning of "Statistical Method," it is necessary to assign to the term "statistics" a definite meaning, and, in my opinion, it is not only desirable but necessary that the definition decided on should be in accord with the language of business men. I would therefore suggest the following definitions:—

I. A "Primary Statistical Quantity is a number obtained from numbers representing phenomena, with a view to enable an observer to perceive certain other phenomena related to the former as whole to parts." [*Example*: the amount of the stock of pig-iron in Messrs. Connal's stores in Glasgow at any date; the receipts of the London and North Western Railway during any week; the number of deaths in the western district of London during any week; the rainfall at Greenwich during any day.]

II. The term "Statistics" always means statistics of *something*, and statistics consist of an orderly collection of primary statistical

quantities. [*Example:* the “statistics of coffee” means a statement, arranged in a systematic form, of the “stocks, landings, and “deliveries” of coffee in London (or some other place), extending over a length of time, varying according to the requirements of the investigation.]

III. The “Statistical Method” is a scientific procedure involving the employment of “Statistics.” It includes not only the processes by which the statistics are dealt with, *e.g.*, the noting of the differences between the statistics of coffee of any one week and those of the corresponding week in the previous year, but also the superintendence of the processes by which the primary statistical quantities are obtained. With regard to these primary quantities, it may be necessary to observe that they are “primary” in the sense of being the units, so to speak, of statistical investigation. To those who have to compile them they are not, of course, “primary.”

From what I have said, it will be clear that I regard what is commonly called “Statistics,” and which in future I shall call “Statistical Analysis,” as a method of Scientific Inquiry, a certain Instrument of Scientific Investigation, whether it be applied to sociology, to meteorology, or to any other science. In saying that it is an “Instrument,” I mean that its purpose is to enable us to perceive and measure with more or less accuracy phenomena which we could neither perceive nor measure otherwise. In the service which it renders to the man of science it is, therefore, analogous to the microscope, which enables us to perceive magnitudes, and the spectroscope, which enables us to perceive tints, that are not otherwise perceptible to us. The latter analogy is, I think, the closest; but two independent writers have both made use of the former. The one is Mr. J. J. Fox, a late member of the Society, who in a Paper read before Section F of the British Association, July, 1860, and published in the *Journal* of the Society for September, 1860, “On the Province of the Statistician,” wrote as follows:—“Let us consider now the second part of our title, ‘Statistics.’ This stands in an entirely different position from Economic Science. It can hardly be said to be a ‘science’ at all. Economic Science can deduce general laws from the facts of man’s social and political life. Statistics has no facts of its own; in so far as it is a science it belongs to the domain of Mathematics. Its great and inestimable value is, that it is a ‘method’ for the prosecution of other sciences. . . . In making a ‘method’ or instrument a common bond of union between scientific men, we are not singular. The microscope is an instrument for the investigation of science, and is applied to a large circle of objects. It is applied to the sciences of Zoology and Human Anatomy, Physiology and Pathology, to the science of Vegetable Anatomy, to Crystallography, and the

"structure of Geologic rocks. It seems an anomaly to form a Society for the study of things that are small, and yet in practice this bond of union is convenient. The Microscopical Society flourishes, not for the sake of the science of the Microscope, which is a department of Optics, but for the investigation of the several matters to which the microscope is applied." Mr. Fox went on to remark that in like manner the Statistical Method is the common bond of Statistical Societies, and adds many most valuable observations on the nature of the method itself, which I forbear to quote, much as I should like to do so.

The other writer, who compares statistical analysis to microscopy, is Dr. Hübbe-Schleiden of Hamburg, who is the author of a work published last year, entitled "*Überseeische Politik*." He uses statistical analysis with considerable skill for his special purpose, namely, an examination of the probable future of German colonial enterprise. The passage regarding the theory of the statistical method occurs in a note, and is as follows: "*Statistik* is to the sciences of civilised society, what the microscope and the dissecting knife are to the physical sciences, an instrument of inductive inquiry, or rather the only instrument which can help us to determine the facts, and thus obtain the only sound premises for logical conclusions. Just as at the present day only comparatively few men can make proper use of the microscope and dissecting knife, so also unskilful people commit follies, or even do more mischief, with their statistical investigations." He adds, "I always use the word '*Statistik*' in the sense of 'statistical method,' and never in that of Demography."*

There is, then, according to my view, no "Science of Statistics," at least in the sense in which the term is used by the continental writers. There is a Method of Statistical Analysis, which is applicable to, and valuable as an aid in, several physical sciences, but is absolutely essential to Sociology. The reason why it is essential to Sociology is plain, namely, that the unit of sociological investigation is an aggregate, and in many cases an aggregate of a peculiar kind, namely, an aggregate whose existence is not perceptible to the senses, and which can only be placed before the mind in the form of a primary statistical quantity, and can only be investigated by the aid of Statistical Analysis. The process of giving it the form of a statistical quantity is a mathematical one.

Though the employment of Statistics is merely the employment of an instrument, and though there is no one set of phenomena which can be set apart as the field of a "Science of Statistics," nevertheless, there is a certain limited sense in which we are at liberty to speak of "Statistical Science." In so doing we shall be

* "*Überseeische Politik*," von Hübbe-Schleiden, D.J.U., p. 13.

acting in harmony with established precedents set in other departments of human knowledge, for instance, in the department presided over by Spectrum Analysis, as well as that referred to by Mr. Fox and Dr. Hübbe-Schleiden, Microscopy. It is found convenient to speak of the science of Spectrum Analysis and of Microscopical Science, on the following grounds :—All complicated scientific instruments require that those who use them should understand them thoroughly, and should be able to adjust them should they get out of order. Now the knowledge which enables the operator to use his instrument effectively, and to restore its efficiency when it is not in working order, is important enough to be termed “scientific.” The claim of any body of knowledge to be considered a science is usually estimated less by the extent of the field of the art to which it is subservient, than by the importance of the end to be gained. Even an oarsman may in a sense be termed “scientific,” though this use of the word savours too much of sporting slang. Nevertheless, any man who has done much rowing is aware that his art is based on knowledge to some extent. “Art,” says John Stuart Mill,* “necessarily presupposes knowledge; art, “in any but its infant state, presupposes scientific knowledge; and “if every art does not bear the name of the science on which it “rests, it is only because several sciences are often necessary to “form the groundwork of a single art. Such is the complication “of human affairs, that to enable one thing to be *done*, it is often “requisite to *know* the nature and properties of many things.” Now the knowledge suitable to the purpose of practising the art of Spectrum Analysis is of a very complicated kind. It necessitates a study both of the instrument itself, the spectroscope, and of the special phenomena revealed by the instrument. Such knowledge is with entire propriety termed scientific. And the same may be said of the knowledge needed for successfully practising the art of statistical analysis.

It may be said that in the case of Statistical Analysis the instrument employed is easily handled, and that it cannot correctly be said to require scientific knowledge in those who use it. I am not myself of this opinion, and I should think it strange if such an idea found acceptance within these walls. It is true that much good statistical work has been done by men who have made no study of the method by which they were working. But this only shows that able men may do much while their knowledge is imperfect. Referring to the supposed uselessness of the study of logic, Mill says,† “Men judged of evidence, and often very correctly, before “logic was a science, or they never could have made it one. And

* “System of Logic,” Introduction, Sec. 2.

† “*Ibid.*,” Sec. 6.

“they executed great mechanical works before they understood the laws of mechanics. But there are limits both to what mechanicians can do without principles of mechanics, and to what thinkers can do without principles of logic.” To this I would add, that there are also limits to what statistical inquirers can do without studying the principles of statistical analysis, an assertion in which I have no doubt members of this Society will concur.

DISCUSSION *on* MR. HOOPER'S PAPER.

MR. WALFORD very much concurred with the conclusion which the author of the paper had arrived at, that statistics did not represent any aspect of science except in the sense of being an instrument for scientific use. No physical inquiry could be conducted skilfully and effectively without the aid of statistics. The telescope, which was so essential to the astronomer and his work, did not embody science in itself, although it might have science in its construction and application. And statistics were to be regarded as an instrument or method (and nothing more) which could be applied in the investigation of other sciences. The reader of the paper stated that statistics had only been in use for half a century. He (the speaker) ventured to say he differed from Mr. Hooper in that respect, for all the writers on political arithmetic of the last two or three centuries, had adopted statistical methods in their investigations, manifesting frequently very great skill in their methods. Such inquiries, indeed, could not be conducted without the aid of statistics for the purpose of comparing one result with another, or the comparative progress or retrocession of one period with another. In all inquiries concerning the progress of population, no other method was available. Numbers and quantities depended in the aptness of their use upon statistical method, and many of the great social problems of the age admitted of no other rational treatment. In conclusion, the speaker remarked that, although he had paid great attention to the paper, and had had the opportunity of discussing the question in days gone by with some of the leading authorities of the age, such as M. Quételet and M. Maurice Block, who had ambitious views regarding statistical science, he had always failed to see that there was really a science in statistics. If there was any science about them at all, as he had already said, it was in their use, in the application of statistical methods to the elucidation of simple facts from complex phenomena without unduly forcing conclusions, or attempting to draw deductions from them which they did not fairly warrant.

Mr. R. GIFFEN had listened to the paper with much pleasure, and he thought it was very valuable to the Society to have a man like Mr. Hooper, who was so well acquainted with continental languages and statistical science, taking so much trouble to acquire and digest a large amount of information for their instruction. With regard to the subject of the paper itself, he must say that he entirely concurred with what Mr. Hooper had said, and Mr. Walford had just enforced. He (Mr. Hooper) had absolutely demonstrated his point, that there was not a science of statistics in the sense of an orderly arrangement of knowledge relating to a single subject, which was usually the definition, or very near it, of what they called a science. At the same time there was a great mass of scientific fact which they got to be acquainted with by the study of statistics, and most people who could devote themselves to the study in that way acquired a great deal of knowledge about different sciences through this instrument of statistics which was really scientific knowledge, and justified the association of statisticians together. He thought it was sometimes to be regretted that statisticians seemed to confine themselves exclusively to one science. If they found some people acquainted with the statistics of trade, they generally found the same people unacquainted with the facts relating to population, and so on with other things, which was greatly to be regretted. One use of the work of a society like this ought to be to stimulate the general knowledge of statistical facts apart from one particular branch of the study. One service which they could render was to bring together all the statistical data about different studies, and popularise and diffuse the information regarding them. There was one difficulty incidental to this discussion which he had observed, and that was, that people when they discussed this question seemed to think that because they demonstrated that there was not a science called statistics, therefore they demonstrated that what statisticians did was not scientific. But this was a misunderstanding, for which there was not the smallest foundation. What they did was to collect and investigate data to aid in the investigation of many sciences, and that was accordingly scientific, although there was not a specific science like astronomy to be called by the name of statistics.