CORRADO GINI: A MEMOIR
(with the complete bibliography of his works)
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CORRADO GINI: A MEMOIR
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ISTITUTO DI STATISTICA E RICERCA SOCIALE "CORRADO GINI"
FACOLTÀ DI SCIENZE STATISTICHE DEMOGRAFICHE ED ATTUARIALI
UNIVERSITÀ DEGLI STUDI DI ROMA
Corrado Gini died in the early hours of 13 March, 1965. The evening before, he was still at his desk — writing his last letter. He met his death in the same quick and conclusive manner that was characteristic of his human encounters.

His sudden departure leaves us with a rich and glittering inheritance. Like the great figures of the Renaissance, he combined within himself the seemingly opposite: tradition and new beginnings, the humanities and a technical bent, and that strange mixture of shyness and aggressiveness which is the hallmark of an age of evolution and crisis.

Gini was born on 23 May 1884 at Motta di Livenza, near Treviso, into an old family of landed gentry. All his life this country ancestry gave him something solid and withdrawn; he could be sociable when he wanted, and a brilliant talker, but it cost him an effort which he made only on rare occasions, when the inner promptings which always pushed him on towards some precise aim either relaxed their grip on him or else demanded the effort in the ultimate interest of his ends and purposes.

It is hard to say whether it was accident or a sure sense of his vocation, of his aims and of the means he would need, which guided the early choice of his reading and studies.

He entered the Faculty of Law in the University of Bologna, but did not choose the law as a profession. His study of the law, however, gave him a taste and a capacity for subtle arguments tending to submit the facts to logic and so to organize and dominate them. Beside law, statistics and economics, he also took mathematics and biology, and from this base his subsequent scientific work developed in two principal directions: the social sciences and statistics. For Gini, the two lines were com-
plementary, in so far as he saw statistics as an instrument for scientific research and as a method for the use of techniques in the long processes through which knowledge advances from initial perception to observation and explanation. As a statistician, his interests ranged well beyond the formal aspects of model-building and methodology to the very laws which govern biological and social phenomena in the fields of research he explored during half a century.

His style and methods are strikingly evident in the very first work he published, *Il sesso dal punto di vista statistico* [1] (1). In this work he discusses the sex ratio at birth; beginning with an exposition of past theories, he proceeds through existing statistical information, new hypotheses suggested by this material, and verifiable consequences to be drawn from these hypotheses to a final check of theory against the statistical data. The outline of the work is simple and straight, its information complete, its methodology limpid and its technical means perfect.

At this early stage already Gini showed himself in full mastery of the kind of statistical information on which descriptive statistics rest, as well as of the calculus of probabilities, which is one of the most important tools of statistical research. Italian mathematicians at that time still looked askance at the calculus of probabilities; Gini studied Bernoulli, Lexis and Czuber, as well as the masters of Italian statistics, Bodio, Messedaglia and Benini. Thus he acquired direct and profound knowledge of a subject which he took all the more seriously for regarding it as an approach to the solution of practical problems. Practical problems were always the stimulus for Gini’s methodological work, which he developed in an original, systematic and rigorous manner and which remained one of his most enduring preoccupations throughout his life. In 1910 he acceded to the Chair of Statistics in the University of Cagliari, and the period between then and the end of the first world war saw his most important contributions to statistical science, which he enriched by many valuable new techniques of measurement.

In later years Gini was reproached for not having developed the mathematical theory of his new indices. Mathematicians who devote themselves to statistics are not satisfied with his coefficients and have a lot of difficulties with them, and it is true that they are often awkward to handle both from a theoretical and from a practical point of view. But absolute values are no less useful for yielding non-analytic functions, and if the mathematicians can appreciate only what is easy from the formal point of view, that’s their look-out. Gini was not the man to sacrifice substance to the requirements of formal techniques, nor did he ever take any interest in the formal extensions which are the mathematician’s delight, and least of all in extensions into abstract fields irrelevant for applications to empirical material.

The international statistical journal *Metron*, which Gini founded in 1920 and ran until his death, like *Biometrika* under Pearson, never accepted articles without practical applications. It is these which distinguish a work of theoretical statistics from an exercise in mathematics, and for the statistician mathematics are simply a tool of his trade and of no interest as such.

During and after the first world war Gini became more and more involved in the social and economic problems of war and reconstruction, such as war losses, raw material supplies, national wealth and income, economic depression and inflation [21, 36, 69, 113]. These interests were connected with an already brilliant career, for by that time he was an adviser to the Italian Government and a League of Nations expert, and known the world over. Between 1917 and 1925 he was a member of numerous Italian and international committees dealing with such problems as raw material supplies, the measurement of income and wealth in states members of the League of Nations, labour, child care, settlement of war debts, etc. But Gini never allowed all these occupations to detract him from his theoretical work, which, on the contrary, drew new inspiration from his practical interests and was guided by them into fruitful directions.

In 1913 Gini took over the Chair of Statistics in the University of Padua. In 1919 he received the Royal Prize for Social Sciences from the Accademia Nazionale dei Lincei. By that time he was lecturing at the Universities of Cagliari and Padua on Political Economy, Constitutional Law, Demography and

(1) The numbers in square brackets refer to the Bibliography of C. Gini’s works published in this volume.
Economic Statistics. Since 1911 he was a member of the Consiglio Superiore di Statistica.

His move to the University of Rome in 1923 marked the beginning of a nine-year period when his public activities reached their peak.

At the University, he founded a lecture course on sociology, which remained in his charge until his retirement; set up, in 1928, the School of Statistics, to train statistical personnel for public office, and, in 1936, the Faculty of Statistical, Demographic and Actuarial Sciences. This latter was a protagonist of daringly novel views far in advance of their time; in Italy, it had to wait until 1950 for a spectacular development which by now has raised the number of students to more than 2,500, and abroad it became an early precursor of all the recent schools of operational research modelled on its present structure, including the brand-new Department of Demography established this year at the University of California.

In 1929 Gini founded the Italian Committee for the Study of Population Problems (Comitato italiano per lo studio dei problemi della popolazione) which, two years later, organized in Rome the first Population Congress, to be followed, after the second world war, by a series of international population congresses under the auspices of the United Nations and of the International Union for the Scientific Study of Population. The Committee's research programme was based on a very broad concept of demography, which encompassed the relationship of demographic phenomena with the physical environment as well as all their other biological, economic and social aspects. The Committee survived all postwar difficulties thanks to the extraordinary interest attaching to its work, and the latter's high quality up to the war; the main achievements to its credit are the publication of a series of volumes of source material, Fonti Archivistiche per lo studio dei problemi della popolazione fino al 1943, and the scientific expeditions for the study of isolated population groups, which Gini, as President, organized and directed. Today, the Committee's official journal is still Genus, which Gini founded in 1934.

Another journal which owed its origin to Gini was La Vita Economica Italiana; this was founded in 1926, recorded current economic developments until the war and closed down in 1943.

Corrado Gini was elected to membership in a large number of scientific academies in Italy and abroad; he taught and lectured at many of the major universities in Europe as well as in the United States, Japan, India and Latin America. Honorary degrees were conferred upon him in Economics by the Catholic University of the Sacred Heart in Milan (1932), in Sociology by the University of Geneva (1934), in Sciences by Harvard University (1936), and in Social Sciences by the University of Cordoba, Argentine (1963).

In 1926 Gini was appointed President of the Central Institute of Statistics in Rome. He organized it as a single, co-ordinating centre for all the official statistical services of Italy and raised it to a high level of technical excellence and productivity. But the times were changing, and Gini's independent and impatient spirit would not tolerate interference with his work: he resigned in 1932.

New honours were to come. In 1933 Gini was elected vice-president of the International Sociological Institute, in 1934 president of the Italian Genetics and Eugenics Society, in 1935 president of the International Federation of Eugenics Societies in Latin-language Countries, in 1937 president of the Italian Sociological Society, and in 1941 president of the Italian Statistical Society; in 1957 he received the Gold Medal for outstanding service to the Italian School, and in 1962 he was elected a National Member of the Accademia dei Lincei.

Gini was one of the most distinguished and also one of the most active members of the International Statistical Institute, of which he was an honorary member since 1939.

II. — CONTRIBUTIONS TO SOCIOLOGY, DEMOGRAPHY AND ECONOMICS.

In Italy, Corrado Gini is known principally as a statistician, head of a school and pioneer, but abroad many hold him in high regard also as a demographer and sociologist.

In demography, Gini's name is linked with Rodolfo Benini, in sociology with Vilfredo Pareto of even greater fame. But, demographer and sociologist like the former, economist like the
latter, Gini knew ever since the earliest years of his scientific meditations, how to unite all the human sciences. He recognized the true nature of the unity of population, which, far from being an amorphous and artificial aggregate, is a differentiated and organized group which is born, develops, changes, undergoes crises and sometimes dies.

In Italy, the prestige of Benedetto Croce had long prevented sociology from ranging itself among the social sciences; Italy's sociological tradition, therefore, had to take refuge with the statisticians, where it found the basis of positive sociology in the true sense. Gini's positive sociology has its starting point in demography, which is the science of population as the body of society.

As early as 1912 Gini published a short work called *I fattori demografici dell'evoluzione delle Nazioni* [IV]. If one looks back today to this work, to its developments and to the environment in which it was written, one readily understands how revolutionary it must have seemed at the time.

For the statistician, any self-sufficient population is a society, and sociology is the study of society's life. This concept of society, as having a body and an organization, in itself implies a positive sociology which must draw on demography, biology, history, economics, psychology and ethnology, without identifying itself with any of these other disciplines; but, in asking them to reply to certain problems, it may well require them to step beyond their past boundaries. This is the origin of Gini's comprehensive conception of demography, which has been called "integral demography" and which demands that research on population should be the point where all contributions from all branches of the human sciences converge.

The independent variable in Gini's set which represents society is one which lends itself readily to statistics, and he shows that the rise and fall of nations is the same as the rise and fall of their population.

Nobody since Malthus had gone so deeply into the social effects of demographic factors. Malthus himself was concerned more with the marginal and potential aspect of the relation between demographic growth and social crisis; it was a pathological aspect which had assumed an importance altogether out of propor-portion with the real magnitude of the problem under the impact of the very brilliance of Malthusian demographic, historical and sociological analysis and of the keen sense of uneasiness which spread throughout European society in the eighteenth and nineteenth century. A third contributing factor was no doubt that the rising middle class of left-wing intellectuals sought to further its own economic and political ends by brandishing the weapon of brotherly love towards the teeming multitudes of desperately poor city dwellers.

Gini put the problem of population growth back into proportion, in terms of its normal physiological function accompanied by other manifestations of society's progress, such as the growth of income and of the spirit of enterprise characteristic of a population with a high proportion of young people. His work opened up new horizons for the scientific study of human societies. Combining the heritage of Pareto and a mechanistic approach to social equilibrium with a functional approach in which all the manifestations of social life are linked together in one unitary, teleological and causal perspective, Gini rejected the view that social matters can be reduced to psychological interaction between individuals. He did not deny the importance of psychological factors and indeed penetrated to the very limit where psychological explanations can take over, but he refused to admit that psychological interaction between two individuals constituted the substance of society. It is a futile effort to push the analysis of social facts as far as the psychological elements which ultimately underlie all human action, because the opposite process, which starts out from psychological interaction, can never broaden out into a dynamic process of society — as indeed is proved by all the work done by the psychological school, especially in its American branches.

This early work of Gini's [IV] already contained the fundamental ideas of one published almost twenty years later, in 1930, almost simultaneously in Italian and in English, under the respective titles of *Nascita, evoluzione e morte delle Nazioni* [XXVIII], and *The cyclic rise and fall of population* [215].

In the meantime, Gini worked out the theoretical basis of a coherent system of positive sociology in the true sense, and published it in 1924 in *Patologia economica* [XIX] and in 1927 under
the unfortunate title *Neo-organismo* [XXIII]. The title was unfortunate because, although the text was so clear that it should have removed any doubt, there were few who understood that neo-organicism is entirely different in substance from the organist doctrine, which is as old as sociology itself and as sterile as its literary excursions. There are still not many who know that when we speak of society as an organism we mean not that society resembles this or that other living animal organism, but simply that society has certain fundamental properties in common with biological organisms. And it was not Corrado Gini who invented these properties; they are a discovery of the biochemists. When dealing with the structure of matter at the boundary between the organic and the inorganic, it was found impossible to define a living being in terms of its life, because no-one knows what life is; biochemists therefore tried to define directly what is a living being — that is, an organism. The results of this endeavour may be said to be of no less importance than the discovery of the identity of matter and energy in physics. This latter immaterialized the world, the former widened the boundaries of life. They all reconfirmed the structural identity of the infinitely large and the infinitely small.

The biochemists' definition of organism does not say what an organism is, but says that an organism is a system which has certain properties. It may indeed seem strange that in trying to identify what is common to all living beings, all that was found were certain relations which occur also in associations of living beings. But this is the origin of a modern concept of organism, that is, of a living being, which covers a much wider field than that of traditional biology. This concept is abstract and mathematical, but for this very reason creative. Its elements are a plurality of subjects in a state of equilibrium, which the organism seeks to preserve and to reestablish when disturbed.

To Gini belongs the merit of having crowned the work of the biochemists by introducing the concepts of evolutional and involutional equilibrium and of self-regulating development. But his greatest merit, we should say, was to have had the courage to defy the biases and prejudices of the intellectual world and to have carried his work through to its ultimate conclusions.

Before Gini organicism never became more than a formal model. For centuries it had remained in a state of intuition which, however profound, was fated by the absence of supporting scientific notions to disperse itself ineffectually in literary flights of fancy. By giving it a scientific base, Gini transformed organicism. Demography, economics, history, social psychology, anthropology, public health, law, archaeology, human geography now all became different branches in the study of one single subject: population. Population itself ceases to be an abstract category of a certain number of individuals living in a given territory, speaking the same language, or having the same colour or the same religion; it becomes a social body, a true unit with an organization of life's structures.

Gini was also a pioneer in developing the fundamental interests of the European sociological tradition in terms of the actual conditions of the societies of Europe, under their weight of institutional, economic, religious and political problems.

The scientific construction of a system of organicist sociology required, and still requires, a formidable labour. Gini chose for himself the crucial, but also the least grateful, task. The intuition that society was an organism needed to be demonstrated as true. With the definition of an organism this had become possible, and Gini provided the demonstration in terms of the economic aspects of the life of modern societies.

The "new organicism" as such is dated 1927, but, as was noted before, it had a predecessor in *Patologia economica*, published in 1924. Here we find, for the first time, an interpretation of some of modern society's economic mechanisms as mechanisms tending to preserve and re-establish equilibrium. The effect was somewhat surprising.

Organistic theory has its roots in biology, but considers the unity of the social body as a postulate as evident, irrational and necessary as the postulate of infinity in mathematical analysis. Given its — real or assumed — involvements with philosophy, religion, and the social and natural sciences, such a theory was bound to lend itself badly to discussion, let alone acceptance, from the psychological point of view.

Certainly Gini's caution in treating the argument, and the strictly economic limits within which he maintained his demonstra-
tion, did much to transform into a work of economics one which really was a work of sociology. What happened in the event was that the central thesis was neglected or at best regarded as an interesting working hypothesis, while high praise went to the economic treatment. Thus Gini's reputation as an economist grew. Indeed even if, like Amoroso, one were to consider Gini's *Patologia economica* as a sort of non-Euclidean economics, the fruitfulness of its viewpoints is obvious.

Much has changed since 1924. Ideas that seemed revolutionary then, have become part and parcel of the common store of knowledge and today their origin is obscure. The little volume of *Economic Pathology* which Gini published in 1924, grew through successive new editions to a tome of 600 pages, which have stood the strict test of experience during the second world war. The book's economic interest has been enhanced, but its fundamental idea, which unifies the whole and transforms abstract economics into economic sociology, is still in the background. It is obscured, maybe, by the very brilliance of Gini's economic analysis of particular matters, or perhaps by his capacity to follow each question through to the end, turn its terms upside down and resolve its most patent contradictions. Although it is precisely his organicist theory which enables Gini to harmonize disparate theories and contradictory observations in the field of the social sciences, every single result is so interesting in itself and so clear that it helps in some way to obscure the grand outline. One ends up by not seeing the wood for the trees.

This state of affairs may owe something also to Gini's instinctive aversion to the painstaking labour of detail which is indispensable for the definition of a system. In every field, in statistics, demography, sociology and economics, Gini disliked treatises. These are something closed, archives which preserve the past but open no window to the future; but Gini, true statistician that he was, liked to be always in the vanguard of ideas.

III. — Contributions to the Methodology of Statistics.

Corrado Gini's contributions to statistics divide readily into two separate periods. Roughly up to the beginning of the second world war, Gini concentrated on forging the instruments of his method; thereafter he reviewed and redesigned it as a whole. The first was a chiselling work of analysis, mainly employing specialized techniques towards limited and particular aims, yet governed and oriented by an implicit intuitive overall vision; the second was a critical work of synthesis drawing its form and substance from the particular techniques worked out in precedence.

All the chief methodological contributions and applications fall into the first period, while the critical review of principles, which ultimately gave Gini's method its unity, belongs to the second period. The main works of the first period may be grouped as belonging, respectively, to the theory of averages, the theory of variability and the theory of statistical relations.

*The Theory of Averages.*

Gini's contributions to the theory of averages are concerned both with the general concept and its development over time and with the study of particular averages and their interrelations. Outstanding in the first category is the extension of the calculus of averages to qualitative characteristics or attributes. This rests on the idea that, while the intensity of what Gini called modalities cannot always be defined without arbitrariness in the case of attributes, the intensity of the deviation as between modalities can always be defined, with reasonable conventions. Attributes can either be ordered or not, and if so, they can be ordered in linear or cyclic series. In the first case, the qualitative characteristic becomes a quantitative one, in the second case its modalities can be represented by the points of the circumference of a circle and the mutual deviations can be defined by the relative distances. In the case of a non-ordered series, the modalities can be localized only at the vertices of the fundamental \( n \)-hedron in \( n \)-dimensional space, and hence the deviations must be assumed to be all equal.

The measurement of deviations as between the modalities of qualitative characteristics brings the latter at once within the scope of the calculus of averages, which, in the field of quantitative characteristics, can be defined also by certain properties of the deviations. This certainly applies to the arithmetic mean.
and to the median. Gini and Galvani [203] systematically treated this problem of extension, basing themselves on Hankel's well-known principle of the preservation of formal laws, and subsequently went on to examine also the problem of how to determine the mean of dependent series with several quantitative or qualitative characteristics.

The fundamental importance of this work resides in the fact that it immediately widened the field of application of quantitative treatment to phenomena so far excluded — even though it was a field hardly explored by methodology.

As regards analytic averages, Gini [400] gave a very general formula which covers, as particular cases, the power mean, the mean of power-sums, and the combinatorial power mean. Castellano (*) later studied the group of transcendental surfaces which the function expressing this latter mean describes when its parameters vary.

Lastly, mention needs to be made of Gini's and other authors' application of the concepts of centre of gravity and median centre to populations of various territories [313], in so far as this, too, has its importance in the context of methodology.

**Variability.**

Under the title *Variabilità e Mutabilità* Corrado Gini published, in 1912, a slender volume [V-24] (†) which was revolutionary in Italy, in so far as statistical method here appears for the first time conceived and constructed as a discipline of its own and is treated in a completely original manner different from anything so far customary. Under the influence of research in the natural sciences, astronomy, physics, anthropology, and biology, statisticians abroad had studied mainly the distributions of errors of observation, or of characteristics which, like anthropometrical ones, behave as if every observed value were the imperfect measurement of one single magnitude. As a result, all research concentrated on the objective mean as referring to the only really existing magnitude; this mean thus became the point of reference for every term of a distribution (and, hence, variability was measured by the average deviation of the various terms from the mean). Gini, on his part, was not hamstrung by interests in any particular field, and ranged freely throughout the wide expanses of pure method, the common denominator of all experimental sciences and the mainspring of all applied statistics; this is how he came to define a measure applicable to all the characteristics whose dispersion does not follow the normal law and for which the mean has only subjective significance. This is a characteristic quantity which is useful in that it leads to a certain economy in the representation of the series and is quite satisfactory from the particular point of view of the properties expressed by the mean, which make the latter equivalent to the series. In the case of these characteristics the mean is hardly ever a primitive value from which the distribution derives, but rather a function of this distribution, so that there is no point in linking the measurement of variability with one or the other mean. These characteristics, incidentally, include economic and financial ones, and it was only for lack of anything better that Quetelet applied to them such variability measures as were in use for other characteristics. Gini now proposed as a general measure of dispersion the *mean difference*, which is the average of the absolute differences of all possible pairs of variate values. Through the mean of these differences, the mean difference in a certain sense reflects the mean of the terms; indeed, but for a coefficient, the quadratic mean difference coincides with the standard deviation, and the simple mean difference is expressed as a function of the median. This, however, is due to the fact that, like every other characteristic of a distribution, the mean difference depends on as many independent parameters as the distribution itself does, and that, complications in the formulae apart, these parameters can be chosen arbitrarily. Hence the mean difference can be made to depend not only upon one particular mean, but on two, three... $n$ means; conversely, in an arithmetic mean expressed by its terms, every indication, and, I am tempted to say, the very name of arithmetic mean can be


(†) Reprinted in [XLV] and in [LXIX].
made to disappear from the mean deviation from the arithmetic mean. Such transformations, too, are useful, because they show up yet other properties, even though these are not independent of those mentioned before; the crucial question is whether these properties are interesting or not.

The question of the use of the mean difference and of the other indices of variability is a conceptual one, and as such uncontestably resolved by Gini's own clear statement of principles. But in the storm of controversy which broke out in Italy, there was no debate of the ideas itself and no consequent spontaneous generation of new ideas — different and opposing maybe, but at any rate novel and therefore capable of leading to progress even if they did not themselves constitute progress; instead, all we got was on outcry of the establishment threatened by the march of new ideas, a superficial and outward dispute which spent itself in attacking particulars without ever showing any awareness of the essentials. Today, after so many years, we can look at this strange spectacle with detachment, and we can certainly take no satisfaction from the absence of any constructive critique, which, by reconsidering the concepts and recasting their form, might have transformed conclusions into premises capable of new developments. This, perhaps, is the reason why Variabilità e Mutabilità was somewhat in advance of its time; if nevertheless we witnessed the vigorous growth of a school around these ideas, this was due to their intrinsic and original vitality.

Sooner or later, according to the prevailing scientific climate, the work found interested readers also abroad. In France and Belgium reactions were somewhat slow; in England, where the work later gained high recognition, the very first response was a blistering review in the *Journal of the Royal Statistical Society*, where the writer, his eyes firmly glued to the true-blue Biometrika, rejected as undesirable the very adoption of the word "mutability" to designate variability of qualitative characteristics. (*)

In Germany the work received an immediate and enthusiastic welcome by Lexis (*) and Czuber (*). The latter himself worked for some time along the lines of the nascent Italian School, which soon had an imposing construction to its credit, thanks to a quick succession of new contributions. From Gini's own pen came "Indici di concentrazione e dipendenza" [17], "Sulle misure della concentrazione e della variabilità dei caratteri" [36] and "Di una estensione del concetto di scostamento medio" [56] (); at home, Pietra (**), Cantelli (**), De Finetti (***) and Mortara (****), and abroad Czuber and Bowley (****) worked on the calculation of the mean difference, and Pietra in particular on the reciprocal relations and the geometrical properties of the various indices of variability. When, in September 1930, L. von Bortkiewicz (*****) submitted to the Tokio Session of the International Statistical Institute what Galvani in a review (****) called "an organic, unified and theoretically complete exposition of relevant research by different authors", he drew heavily, but without quoting them, on these Italian sources — which he might have known directly, but more probably became acquainted with indirectly through Czuber, Lexis, Julin, Bowley, Gumbel and March. This episode is recalled here not with the intent of reviving the violent polemics with the International Statistical Institute which were

(*) W. LEXIS, Jahrbücher für Nationalökonomie und Statistik, September 1914.
(***) Reprinted in [XLV] and in [LXIX].
(*****) F.P. CANTIELI, Sulla differenza media con ripetizione. Giornale degli Economisti, 1913.

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cut short only by the death of Bortkiewicz (19), nor of belittling the merits of one who, under so many aspects, deserves to be regarded as a true master; but this great scholar’s authority is in itself the best witness to the level to which Variabilità e Mutabilità had at once raised Italian statistics, which was soon to transcend the narrow boundaries of its homeland in spite of all the hostility of Anglo-Saxon statisticians (19).

A particularly important measure, which Gini [36] called the concentration ratio, is obtained by dividing the mean difference by twice the arithmetic mean, $2A$. $2A$ is the maximum which the arithmetic mean may attain when the total quantity of the characteristic in any distribution is redistributed in all possible manners among its units, or the arithmetic mean is left constant even if the number of units varies. Gini did much to develop the general theory of constrained maxima of variability indices, and proposed that the name of relative index of variability should be reserved exclusively to the absolute index divided by its maximum, leaving those where the absolute index is divided by some mean value to be called percentage indices.

The concentration ratio or coefficient of concentration $R$ owes its name more specifically to the particular aspect of variability which is known as concentration. Unless a characteristic is constant, the different units of a distribution possess this characteristic in varying quantities ranging from a minimum, which may be zero, to a certain maximum, which may be limited only by the total available quantity of the characteristic. Theoretically this applies, for instance, to income, which may be concentrated in the hands of one single individual, while all the others have no income at all; it certainly does not apply, on the contrary, to the height of persons, which varies within rather narrow limits. If, therefore, a characteristic is variable, the units of the distribution can be arrayed in the order of the intensity of the characteristic (gradation curve); the more units there are which possess only a little of the characteristic, and the less of it each of these possesses, the more is that characteristic concentrated in the remaining units, which possess relatively more of it.

If the units are arranged in ascending order of the intensity of the characteristic, the total quantity of the characteristic possessed by the $n_i$ less well endowed units represents a fraction $q_i$ of the total quantity $M$ of the characteristic. In case of zero variability, this fraction would equal a proportion $p_i$ of the $n_i$ units in the total $N$ units in the distribution, but otherwise $q_i < p_i$, and all the more so the more the characteristic is concentrated.

The simplest and most obvious measure of concentration, therefore, is the mean of the ratios

$$ R_i = \frac{p_i - q_i}{p_i} \left( = \frac{(x - q)}{(1 - q)} \right) $$

for $i = 1, 2, \ldots N$.

These ratios express the concentration of the characteristic in ordered, and increasingly more numerous, groups of the total; $R$ is the weighted arithmetic mean of the values $R_i$, the weights being equal to the denominators.

The function $q = q (p)$ describes on the Cartesian plane a curve (curve of concentration, or Lorenz curve), which ranges from $(0,0)$ to $(1,1)$ and is concave to the straight line $q = p$, with which, in the case of zero concentration, it coincides for the interval $0 \leq p \leq 1$. The area in the first quadrant between this curve and the line $q = q (p)$ is called the area of concentration, and $R$ also equals the area of concentration divided by its maximum.

Very many authors made important contributions to the theory of concentration.

Besides $R$ we have another mean index of concentration in the mean of the exponents $\delta_i$ defined by the relation $1 - p_i = (x - q)^{\delta_i}$. The values $\delta_i$ increase with increasing concentration, and so does every mean of them. If the Gini curve [17]
[1 - \phi = (1 - q)^{\delta}, where \delta = M (\delta_i), for instance \delta = \Sigma \delta_i/n] has a good fit with the empirical concentration curve of the distribution \( q = \varphi (\phi) \), then \( \delta \) is also a descriptive index of concentration for the relation between \( \phi \) and \( q \). This happens to be so in the case of many income distributions, and for this reason Gini’s \( \delta \)-index has been compared with the parameter \( \alpha \) in the Pareto graduation curve of income distribution; this, too, may legitimately be interpreted as a descriptive index of concentration, in cases where the corresponding theoretical distribution has a good fit with the empirical distribution. Because the Pareto \( \alpha \)-curve and the Gini \( \delta \)-curve are, in certain conditions, functional transformations of each other, it is sometimes forgotten that the question is really one of interpolation and as such must be resolved empirically in a well-defined field through testing the fit against the values of the theoretical distribution. Gini [24] and Savorgnan (17) argued that \( \delta \) was more sensitive and precise than \( \alpha \), and later Castellano (19) lent additional rigour to their argument by applying an objective criterion for comparing the two curves’ goodness of fit.

Gini’s Variabilità et Mutabilità marks the beginning of the systematic study of qualitative characteristics. Prior work on this subject by Galton, Pearson and Yule was devoid of any rigorous method. By extending the calculus of averages to qualitative deviations and broadening the concept of mean deviation, Gini enabled the Italian School to remove every obstacle to the study of the distributions of qualitative characteristics, which can be treated exactly like quantitative ones. Castellano (18) subsequently showed that it was convenient, to this

\begin{enumerate}
  \item V. Castellano, Vecchi e nuovi problemi nello studio delle distribuzioni dei redditi. Giornale degli Economisti e Annali di Economia, July-August 1949.
\end{enumerate}

end, to break up the cyclic series into as many linear series as there are modalities of the characteristic with a frequency other than zero.

Other particular aspects of variability include asymmetry, normality or abnormality, and disnormality of distributions; Gini made outstanding contributions to the analysis of all of them [602-623].

**Statistical ratios and methods of elimination.**

Corrado Gini’s outstanding contribution in this field was that he recognized the close link which exists between the theory of price index numbers, which has been developed so much in these last fifty years, especially abroad, and the methods of standard population and standard mortality rates, and that he combined seemingly different methods and procedures in his theory of elimination. In a paper [121] which has now become classic, Gini stated and solved the logical and technical questions involved in these methods, and illustrated their applications.

In another work [386] he discussed the related subject of the methods for eliminating the influence of various groups of factors; this is introduced by a penetrating critique of the models used for studying the effects of the various components of collective phenomena. Other relevant papers deal with the measurement of the fecundity and fertility of marriage, fecundability, etc.

The determination of the probability of elimination by means of the average rate of elimination, which is another of Gini’s contributions, goes well beyond the narrow actuarial field; from this, Gini derived his method of exact durations [347], which rivals Ackland’s homonymous method in actuarial statistics. But Gini’s method has a wider range of validity, as Castellano (21) has shown in his systematic discussion of the determination of elimination rates in a non-homogeneous community, after elimination of the influence of the particular frequencies of the chosen groups; Castellano pointed out that, whenever possible, the prob-
ability ratio should be treated as a composition ratio rather than as a derivation ratio.

**Statistical Relations.**

The study of statistical relations is one of the largest and most important branches of methodology. Outstanding contributions to its progress had been made by Bravais, Galton, Pearson and Yule, to name only a few of the most distinguished names; but before Gini no-one had taken an overall view of the subject. In this field the Italian School did valuable work of innovation, clarification and systematization.

This work may conveniently be discussed under three separate sub-headings, as follows:

(a) Relations between the mean intensities of two phenomena. When two distributions are synthetically represented by their respective averages, the relation between the magnitudes of the two averages is applicable to individual cases only via the détour of probability. Take the statements, for example, that men are taller than women, or that individual incomes are lower in Italy than in the United States. These statements express something very precise, namely that, in equally numerous groups, the sum of men's heights exceeds that of women's, and that the arithmetic mean of income in Italy is lower than in the United States; but they do not say that the same difference obtains in any particular case, as between any one man and any one woman, a specific Italian and a specific American. The frequency with which this relation does in fact occur in individual cases is called its "degree of typicalness"; this is unity when the relation always occurs (the maximum of one distribution is less than the minimum of the other), and equals zero when the relation occurs and fails to occur in the same number of individual cases. This degree of typicalness is measured by the indices of "transvariation", which Gini introduced [43] and, in collaboration with Livada [493], extended to characteristics of more than one dimension. Other contributions to the subject came from Castellano, Ottaviani, Dagum, and many others [25].

(b) Relations between distributions of two phenomena. The problem is to find a synthetic index which gives a combined expression of all the differences between the two distributions. Two approaches suggest themselves: to account either for the differences between the relative frequencies of equal quantities in the two distributions, or for the differences between the quantities themselves, in appropriate pairs. Along the first line, there is a not altogether successful attempt by Boas [2]; the second approach is that of the Italian School. The first rests essentially upon the comparison of frequency curves, the second upon the comparison of graduation curves. This latter method is justified by the fact that if, in two groups reduced to the same number of quantities, these are paired one by one, the sum of the absolute values (or their squares, etc.) of the differences between the corresponding quantities is smallest when these quantities are cograduated.

The arithmetic mean of the absolute values of the differences between cograduated quantities is taken as an absolute index of dissimilarity, the quadratic mean as a quadratic index, etc. It is to Gini [35] that we owe the theory of indices of dissimilarity, which today have come to signify also the distance between two distributions; Salvemini [23] made notable contributions to it, and recently Leti [24] provided a satisfactory solution to the problem of multidimensional dissimilarity, following the procedure adopted in the transport problem.

(c) Relations between the individual modalities in two distributions [45-47-48-51-378-445-449-707]. Two characteristics are said to be "correlated" if they pertain either to one and the same series of statistical units (e.g. the height and weight of individuals in the same group), or to two distinct series of units which correspond bi-univocally to each other in pairs (e.g. the age of bride and groom at marriage). As a result of this cor-

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[25] All the major ones are published in [LXXVII].

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respondence the intensities of the two characteristics are associated in such a way that to every quantity \( x_i \) of one there corresponds a quantity \( y_i \) of the other, and vice versa. This association is like the effect of a selection which may be made in different conditions, having a major bearing on the results. Association may antecede the distribution, as happens in the case of free association between units of two far more numerous groups (this is generally the case of marriage); it is, then, in a certain sense, the association which determines the distribution of each of the two correlated characteristics. Conversely, each unit of a group may be obliged to associate with a unit of another given group; then any tendency which certain modalities in both groups may have to associate with each other cannot generally find free expression, because selection is limited by the predetermination of the two characteristics' distribution. Suppose, for example, that in a ballroom men and women of equal height tend to choose each other for dance partners; this tendency cannot manifest itself in full, if all of them want to dance at the same time and there are more of the tallest people, or more of the shortest, in one distribution than in the other.

Two characteristics tend to associate with each other in a particular manner when the distributions of modalities of one characteristic associated with a particular modality of the other differ from each other. Suppose, for example, that all the sub-distributions of the characteristics \( A \), each of which is associated with an individual modality of the characteristic \( B \), are similar among each other (which means that all the relative frequency curves are equal) and hence also to the total distribution of \( A \); in this case the association displays no influence by the modality of one characteristic upon the presence of the other's modalities, and the two characteristics show no "connection". When, on the other hand, there is a connection, it can be measured by a mean of the indices of dissimilarity between the sub-distributions of \( A \) according to \( B \)-values and the total distribution of \( A \) (connection of \( A \) with \( B \)-values), or between the sub-distributions of \( B \) according to \( A \)-values and the total distribution of \( B \) (connection of \( B \) with \( A \)-values).

If there is a connection between two characteristics, and both of them — whether quantitative or qualitative — are at least such that every modality of each can be made to correspond to a similar modality of the other, then it becomes possible to try and measure the tendency of association between similar modalities. This is done by concordance indices, of which rank correlation coefficients are a special case (Gini's index of cograduation, Spearman's \( \rho \)); these are obtained when, in both the associated distributions, the intensity of the characteristic is replaced by the corresponding ordinal number in the respective rankings (the index \( i \) is substituted for \( x_i \)).

The indices of both connection and concordance are obtained by dividing the effective measures of connection and concordance by the possible maxima they may obtain; it being assumed either that association does, or does not, depend upon the pre-existing distributions of the two characteristics. Coefficients of concordance obtained on the first assumption were called indices of homophily by Gini, those obtained on the second assumption are called coefficients of correlation. The correlation coefficient of Bravais is a quadratic index of correlation; the Pearson correlation ratio is a quadratic index of connection between the mean intensities of one characteristic and the modalities of the other.

It was Gini who constructed the whole theory in this form, and everyone familiar with the debates at the International Statistical Institute on the significance and use of the coefficient of correlation will readily appreciate how much clarity and order he thereby brought to a field in which ideas used to be most confused. Yet twenty years or so were to pass before the greatest of the international organizations was to open its doors fully to let in this clarity and order.

Gini extended all these concepts also to qualitative characteristics, and many others, pupils of his or not, made valuable contributions to the theory (26).

Representative series. Applications of the Calculus of Probabilities.

With the steady enlargement of the field in which government intervenes, and which by now extends to the control and

direction not only of economic but of all social affairs, the authorities' need for more and more information assumed enormous proportions. Accordingly, new means to satisfy this need had to be created, or existing ones improved. Where statistical organization is satisfactory, statistics become a mere matter of keeping accounts (e.g., register of birth, marriages and deaths). But things are not always so satisfactory; especially since the desire of government to base its conduct on knowledge of facts keeps growing by leaps and bounds, there are always large areas of government activity where there is little or no possibility of getting at the material directly or indirectly. In that case there invariably arise important questions of how to extend available information to related fields or to greater areas, and the same applies to such enquiries as can be carried out and which so often fall short of what would be desirable. The mere cash accounts of giant enterprises, such as a state as a whole always is, are difficult enough to keep, given the enormous number of entries which must be grouped in some way if one is to gain that sort of comprehensive view by which alone the subject can be mastered and the analysis of innumerable details made to serve general purposes. This is why methodology has been called in more and more as an aid also in official statistics.

In other countries, the part of methodology which is most closely connected with applications is often incorporated into the respective user disciplines, and accordingly has become the special subject of the staffs of interested statistical offices; the writers of treatises have left the subject largely alone, apart from the mathematical theory of sampling, including the question of statistical estimation and inference, of which more will be said presently.

In Italy, on the other hand, we find careful methodological treatment extending also to indirect and largely conjectural statistics such as estimates of income and wealth. To mention only the earliest and the latest of the relevant works, we may quote Gini's L'ammontare e composizione della ricchezza delle Nazioni [VII] and the Central Statistical Institute's volume Studi sul reddito nazionale (Series VIII of the Annals, Vol. III, 1950). All the different stages of the work of official statistics are here set out schematically with close reference to real conditions, and

the problems concerning the applications of the calculus of probabilities are discussed in concrete and at the same time scientific terms.

The whole of the life's work of the prolific author that Gini was, was one long road leading up to his critical review of the principles and methods of statistics, which was to become the pride of the Italian School in the 1950s. The road began as long ago as 1908, when Gini, in Il sesso dal punto di vista statistico [I], drew from the theory of dispersion everything that the most weighty statistical material ever collected by any statistician in any country could be made to yield; near the end of the road we have the milestone of Di un'applicazione del metodo rappresentativo all'ultimo censimento italiano della popolazione [XXVI]. Everything fits in with this grand design: the considerations on posterior probabilities [22], the question of average man [28] and the criteria by which to assess whether an individual's proportions are normal [399], the method of least arbitrariness for the determination of the frequency of blood groups [344].

IV. — CRITICAL REVIEW OF STATISTICAL PRINCIPLES AND METHODS.

Around 1940 the current of thought which had inspired the young Italian School in the thirty years of its life reached its maturity and slowly but irresistibly spread beyond the frontiers of its own language. On the forum of the greatest international statistical organization, the Italian School, with its theory of connection and concordance, showed up the insufficiency of the old Bravais correlation coefficient and the Pearson correlation ratio and in so doing revealed the breadth and depth of its own conceptions. It was demonstrated that neither of these indices could serve all the ends which it was claimed they could serve, that each of them had a certain field of validity and limits which cannot be transgressed; but it was also shown (26) that the long confusion and the need to revise all the applications of the universally known correlation coefficient were by no means to be

if \( x \) follows from \( A \) and from \( B \), the effect \( x \) cannot be attributed to \( A \) or to \( B \) with certainty (the effects \( x \) due to \( A \) being, by hypothesis, undistinguishable from those due to \( B \) ); in that case effects can be attributed to causes only through probabilities. The mere fact that the effect \( x \) is rare among the effects of \( A \) does not imply that \( x \) may safely be attributed to \( B \), since \( x \) may be even rarer among the effects of \( B \) (for instance, an individual 7 ft. tall may be very unusual among men, but it would, to say the least, be somewhat rash to declare that this individual cannot be male, for such a height is even rarer among women). In other words, one cannot decide on the basis of the distribution of \( A \)-results alone whether the divergence of a certain result \( x \) from the normal result of \( A \) is random or otherwise; one needs to know also the distribution of \( B \)-results, etc., which may also produce \( x \). In addition, one needs to know the relative frequencies of the causes \( A, B, \ldots \), for clearly, if the effect \( x \) is frequent among the \( B \)-effects but \( B \) itself is very much rarer than \( A \), there will be many more results \( x \) due to \( A \) than to \( B \), even if \( x \) is relatively rare in \( A \). Take an example: in a public lottery, given its rules, it is extremely rare to win by fraud and it is therefore infinitely more probable that even a quince is won by pure chance rather than by fraud.

All this sounds obvious enough — as obvious as the objections which were raised at a certain moment, once the first flush of enthusiasm for the calculus of probabilities had faded, against all its unjustified applications which had begun to discredit it since the end of the nineteenth century. Nevertheless Pearson unwittingly committed the logical error of confusing the probability \( P_x \) that the result \( x \) would occur among the results of \( A \), with the probability \( P_x \) that the result \( x \) would follow from \( A \); and it was around this error that the theory of estimation and statistical inference was built — a theory which, with its significance tests, confidence intervals, maximum likelihood, and so on, did a great disservice to scientific procedures, because it encouraged the gratifying illusion that the problem of the reliability of hypotheses can be resolved by standard methods. This gratifying illusion spurred on the Anglo-Saxon statisticians, who already had a bent towards the mathematical treatment of certain methodological problems; soon statistics became the playground of
mathematicians. Some of them, to be sure, were very distinguished, and made extremely valuable contributions of detail; they also attached the prestige-carrying label "hard to understand" to those methods whose applications the Anglo-Saxons, with their empiricism in mathematical garb, now began to propagate abroad. Neither the distant voice of Poincaré (28), nor the nearby warnings of Ramsey (29) who meant to knock down by a single page the whole edifice built up by Fisher and his disciples, availed to hold back the wave of enthusiasm.

When Corrado Gini opened the first meeting of the newly founded Italian Statistical Society in 1939 with an address entitled I pericoli della Statistica [418], he not only sounded the alarm bell and put the world of statisticians on its guard against the logical weakness of certain procedures, but at the same time also laid the foundations for a systematic review of the principles of methodology.

Common sense no less than the scholar's caution suggest that it is useless to try and transform statistical induction into deduction. With penetrating logic Gini proved on this occasion how important and unavoidable are prior probabilities in any judgement on the measures deriving from a sample; he restored to induction its essential character of a conclusion based upon an experience (the facts) and an independent and preliminary a priori assumption by which the facts can be interpreted. It does not matter that the a priori assumption itself has been shaped by experience and will be reshaped by the current and future experiences; in all cases the choice has to be made from a set of data with which it can have no deductive links.

A whole spate of papers then followed each other at short intervals: Sur la théorie de la dispersion et sur la vérification des schémas théoriques [431]; Alle basi del metodo statistico: il principio della compensazione degli errori accidentali e la legge dei grandi numeri [448]; I testi di significatività [494]; and The Statistical Relations and their Inversion [541]. In all these works Gini entered into the inmost structure of method, not in the abstract terms of a logician or philosopher, but with a realistic sense of the very essence of methodology, such as only a true statistician can have.

Gini analysed the function of theoretical models and warned against the dangers of their misuse. He examined the scope of the principle of the compensation of random errors and pointed out shrewdly that there were two possibilities: (a) if random errors are defined as tending to compensate each other as the number of observations grows, then the principle is a tautology; (b) if random errors are defined as due to random disturbances, then the principle turns into a principle of the compensation of the effects of random disturbances tending to compensate each other and as such becomes quite unacceptable, because it is simply not true that when the probable value of a variable is 0, the probable value of any one of its functions is also 0. This may happen, of course, but only on specific assumptions — if one assumes, for example, that the probable value of deviations from the mode is zero, or that the arithmetic mean is typical in the wider sense of correspondence with the mode, independently of the condition that the distribution be normal. This is the case of errors of observation, and for these the principle of compensation can be regarded as valid, independently of any knowledge of the distribution of the causes of error. It is justified, therefore, to regard the arithmetic mean of the measures of one and the same magnitude as the latter's most reliable value; it is not justified to conclude the same for the arithmetic mean of the intensities of different magnitudes.

The above hypothesis can be translated into concrete terms by assuming that the effect of random disturbances is nil so far as correspondence with the mode is concerned. This is equivalent to assuming that the constant causes correspond to the mode: we have the principle of the prevalence of constant causes, which, independent as it is of the form of observed distributions and of any knowledge regarding disturbing causes, is subject only to the hypothesis that errors are the more frequent the smaller they are in absolute value. This principle is much more widely applicable than the principle of the compensation of the effects of random disturbances, which involves the use of the arithmetic mean.

In considering possible relations between two variables, Gini \([689]\) made a distinction between relations that are invertible (analytical relations), and those that are sub-invertible or invertible on average or non-invertible (statistical relations). Illegitimate inversion of the probability relations as between frequency and probability is the source of errors in significance tests, for this is an inversion which may not be made in general, but only on appropriate assumptions \([705]\). Gini specified these assumptions for the case of a magnitude with constant distribution, and in collaboration with Livada \([498]\) worked out the expression of inverse probability for the case of intensive magnitudes, on the assumption that the distribution curve of the prior probabilities is analogous to a binomial curve. When this procedure was applied to the problem of sampling inspection, the results differed greatly from those obtained on the more usual assumption of equidistribution of prior probabilities.

Corrado Gini fashioned Italian statistics during the last fifty years. Thanks to him, Italian statistics early in this century overcame the handicap which had until then made it lag behind its Anglo-Saxon counterpart in international circles, and raced ahead to the front rank of scientific progress. Its advance was sped in the twentieth century by the self-same causes which held it back in the nineteenth: 1) Because of the slow spread of the methods of quantitative analysis in all the sciences there was no incentive for their applied branches to develop on their own statistical methods for their particular field; 2) the prevalent philosophical and sociological tradition implied a comprehensive and realistic view of all questions of method, and therefore kept methodology from turning itself into a chapter of mathematics. This is what happened in the Anglo-Saxon countries, where statisticians, no sooner placed on the royal road of probabilistic analysis by the work of Bowley and Gosset, rapidly rushed forward along this line — though ultimately no further, of course, than their mathematical aids could carry them. This is how Anglo-Saxon statistics began its spectacular development, which was yet more intensified after the second world war with the creation of whole new branches of methodology. These could have given statistics the necessary relevance to the problems of its new fields of application, had it not been for the distorting conception which progressively gained the upper hand and ultimately degraded statistics to mere model-building. In the garb of the "new" or "modern" statistics, this construction was set up in opposition to the classical conception of our science, which cannot be wholly confined within the mathematical models into which the "new statistics" is slowly being goaded by the sirens of Techno-Science in the laboratories of industry. In the end we are left with a collection of mathematical procedures and techniques, which all too often are the sole content of so-called statistical treatises.

In Italy, this process of mathematization and abstraction was much slower. As a result, the large complexes of applied statistics which are being set up as autonomous sciences still remain branches of one single larger science, unified at the core by methodology. Statistical method is here conceived not as the formal development of prefabricated models, but as the complete intellectual process which starts with observing individual phenomena and goes forward, through their classification, to creating and working out abstract systems where collective phenomena find their place and become intelligible in a unitary conception. It would be wrong to say that Anglo-Saxon statisticians, with their prevailing mathematical bent, neglect or keep aloof from the empirical world. On the contrary, this world has the strongest attraction for them, but it is hard to grasp and therefore they are intent mainly on fashioning instruments with which to divide it up and so to dominate it. The mathematical methods for statistics take over once the empirical world is dissected into variables and attributes.

It would be equally wrong to say that the Italian statistical school, following Gini's lead, neglects or disdains the theory of sampling and of statistical inference, design of experiments, factor analysis, etc. The Italian School has made its contributions to these branches of statistics, too \(\text{[50]}\); but it directs its attention elsewhere as well, to data checks, elimination rates, etc.,

\[\text{[50]}\] Gini more than once underlined his School's work in this field \([157, 162, 834]\).
variability indices and averages, attributes that can be quantified in linear or cyclic order, attributes that cannot be quantified, and to the observation, critique and representation of data.

The difference between the two currents lies in the limits which statisticians in practice draw to their activity. Background and training have much to do with this. Surely, it was not by accident that both K. Pearson and C. Gini came to statistics from the study of the law. For some, statistics is a specialized branch, a field of application of mathematics. They do, to be sure, keep their eyes on empirical reality; but it is possible to make contact with it at different levels, and for a mathematician an abstract example may already be part of the empirical world. For others, statistics is a generalization of the processes of thought and is applied to empirical facts so as to organize them with a view to comprehension. It is the whole body of techniques justified by a methodology which lends validity to all cognitive processes from observable facts to their explanation by theories. The central point of the cognitive process may perhaps be described as the point where induction and deduction meet: where generalization gives us the starting point for a rational hypothesis or model, which we can then test and develop by deduction. This same central point is also the one where the dominant interest of the two currents of contemporary statistics meet and divide. On the one side, there are the specialized mathematicians, who want to bring more and more mathematical analyses into statistics, and to formalize its instruments to the point, for instance, of an axiomatic formulation of the calculus of probabilities; on the other side are those who study empirical aggregates, tend to develop mainly descriptive procedures and do their best not to lose contact with such particular fields as demography, economics, biology or sociology, which are the source and the end of all experiments. What is required here is systematic reflection and simplicity in the face of the complex empirical world. Perhaps this school places too much faith in inductive processes, but then the other equally overestimates deductive ones, and tries forever to devise rules for induction. At this point the two otherwise complementary currents may come into conflict, which may well lead to clarification and thus turn out to be useful for both.

It may be objected that a discipline so broad as statistics in Gini's sense is hard to master, and that its progress must inevitably lead to its division into specialized branches. But it does not matter how many specialized and particular fields take on separate identity within any discipline, so long as they all consciously remain part of a structured and harmonious whole, where each part has its own justification — and its own difficulties.

Today, there seem to be convergent tendencies in both currents of statistical thought. In Italy, Gini has aroused the mathematicians' interest; on the other side, operational research is tending towards empirical methods, under the impact of the needs of developing countries, which demand from their statisticians more and better information and less theory (31). If this interpretation is correct, the day may not be so far off when statistics as developed by Corrado Gini in a broad conception encompassing the whole process of scientific knowledge, from observation of facts to the formulation of theory, will be seen as the meeting point of the two currents of statistical thought which we have mentioned.

The Faculty of Statistical Sciences of the University of Rome has given the name of Istituto di Statistica e Ricerca sociale «Corrado Gini» to its statistical institute. Under the auspices of the Accademia Nazionale dei Lincei, the Istituto Centrale di Statistica, the Consiglio Nazionale delle Ricerche it has convened an international symposium on statistics to be held, in memory of Corrado Gini, on the first anniversary of his death.

(31) See, for example, the remarks made by P.C. Mahalanobis at the beginning of his address on "Statistics as a Key Technology" in the occasion of the 125th anniversary meeting of the American Statistical Association in Boston, 1965. (The American Statistician, Vol. 19, No. 2, April 1965).
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