# "The Mathematics of Man" by Claude Lévi-Strauss

*Translated by Matthew Carey,*
*with an Introduction by Susanne Küchler*

## Introduction: Mathematics and Anthropology

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Claude Lévi-Strauss's essay "Les mathématiques de l'homme," originally published in 1956, is the least known of all his publications. It is also arguably his most prescient, capturing the enduring possibilities and latent pitfalls in anthropology's relationship with mathematics that have continued to beset the discipline to the present day. The aim of presenting a new translation of this essay is to prompt reflections on the changing landscape of research on and teaching of anthropology, which is still as tangled up with the philosophy and practice of mathematics as it was then.

The question of how mathematics interacts with ideas and with real-world situations has never become a field or even subfield in anthropology. Yet the recognition of its presence underpinning qualitative data has made anthropology into a key ally of the natural sciences in understanding social worlds. Anthropology, we are able to say today, has taken heed of Lévi-Strauss's advice, made explicit in his essay, that using numbers and algebraic formulae to analyze data is based on a misrecognition of the implication of 'the human mathematics' for anthropology. Instead of debasing mathematics to a method, social and cultural anthropology has excelled over the past decades in identifying the kinds of mathematical ideas operative in social life. By exploring the social life of numbers, anthropology has asked theoretically charged questions about the difference that mathematical ideas make to culture and society.

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Anthropology today showcases a sizeable body of literature addressing how calculations in everyday life and in religious imagination are mediated by ideas of number. This literature is not unified in its approach to or understanding of the place of mathematics in social life. Yet there are discernible strands that broadly reflect on real-world challenges met by anthropology head on over the past decades. There are publications on counting systems and their socio-economic and political roles, all almost exclusively during the early 1980s, coinciding with the reclaiming of indigenous territories and rights in emerging post-colonial worlds (Ascher and Ascher 1981; Ascher 2002; Biersack 1982; Gell 1985; Lave 1988; Mimika 1988; Washburn and Crowe 1988); more systematic overviews of mathematical ideas underpinning different types of number-centric social practice, as varied as hair styling, navigation, and displays of personhood (Ascher 1991; Crump 1990; Eglash 1999; Gerdes 1997; Hutchins 1995; Urton 1997; Wagner 1991; Wassmann 1994; Wassmann and Dasen 1994); and explorations of systems of logic and of the difference they make to ethics, accountability, coding, and governance (Damon 2008; Gerdes 2007; Guyer 2004; Küchler 2003; Mosko and Damon 2005; Stafford 2009; Strathern 2000; Urton 2003; Verran 2001); as well as essays and ethnographies on mathematical ideas underpinning calculation within the economy at large (Guyer 2010; Guyer et al. 2010; Holbraad 2017, 2020; Humphrey 2019; Küchler 2017; Maurer 2010; Pickles 2020a,b,c; Silverstein 2020; Stafford 2010).

From the social life of numbers to the place of calculation in the projection of possible futures, anthropology may have strived to give substance to Lévi-Strauss's vision of a 'human mathematics,' but it has largely refrained from engaging with theories in mathematics or with the philosophy of mathematics as developed by Albert Lautman (1908–1944) and Alain Badiou (2008). Instead, anthropology has offered up detailed accounts of the importance of visible, material, and ontological nature of mathematical objects (numbers, lines, graphic, and geometric elements) and of their role as models of complex relations (Rio 2005). By asking how such mathematical objects are known and by charting the difference they make to culture and society, anthropology has avoided treating its accounts as mere indices of the diversity of culture and society.

There are of course several reasons one can think of that might explain why the relation between mathematics and anthropology has remained at the level of the descriptive, having largely refrained from asking questions about what mathematics brings to anthropology, while attempts at rendering qualitative data susceptible to quantitative analysis have all but regressed since Lévi-Strauss's call for a theory of human mathematics. Anthropologists exhibit a reticence in regard to all things mathematical, decried by Lévi-Strauss himself in his laments on the generally inadequate skilling in mathematics anthropologists experience during their training. Not much has changed in this regard, even if biological anthropology can bring to the table training in mathematics critical to its methods. Then there is the prevailing notion that mathematics is expert or institutionalized knowledge that has no parallel in everyday cognition, meaning that, even if one has a vague recollection of set theory or differential geometry, the idea that this theory could be useful to analyze data that are seemingly not quantifiable seems to many far-fetched or even wrongheaded. There is also a rather remarkable absence of scholars of mathematics willing and able to engage with the question of the relation between mathematical ideas and social theory. There are no training camps for social scientists run by historians, philosophers, or academicians of mathematics, and there are too few studies of how theories in social sciences are mathematically informed (Duffy 2013).

Given this rather sad state of affairs, it might be useful to go over the main tenets of Lévi-Strauss's essay to remind us of the misapprehensions that had plagued anthropology in the early twentieth century. When Lévi-Strauss wrote the essay, he was responding to developments that contributed to the incursion of novel and revolutionary mathematical reflections into the human sciences, culminating in attempts to establish a training camp for social scientists financed by UNESCO and taking place over a number of weeks at Dartmore College in the US in 1953/54. In his essay on mathematics and the human sciences, Lévi-Strauss recalls how the ancient preoccupation with mathematics by Pythagoras and Plato, concerned as it was with the image of Man, had taken center stage again in the human sciences around the time of writing his paper in the 1950s. As these preoccupations were removed from any concern with measure, concerned instead with qualitative subject matter, the human sciences were unconstrained by the rigors of the mathematics of measurement and by implication free to turn to new daring and revolutionary forms of mathematical reflection. This allowed the "human sciences" to break free from misleading preoccupations with measure that marked the understanding and use of mathematics at the start of the twentieth century.

The field in which the new mathematics had found resonance was of course the field of linguistics—a field Lévi-Strauss saw as occupying a privileged position in the human sciences—its subject matter being a social concept, in that language does not imply a social life but is the foundation of social life. What would a society be without language, asks Lévi-Strauss, observing that language in fact is the most complex social system that every social science chooses to study at its own level. He reminds us that in fact research undertaken independently by engineers of transmission in the developing field of computing had come close conceptually to the works of Saussure on the systematic nature of language.

With the creation of early computers and a theoretical framework for computing, presented for the first time systematically by the mathematician and engineer Claude Shannon, one finds, according to Lévi-Strauss, certain principles of interpretation that overlap with those of linguistic theory: to know that communication between people rests on the combination of ordered elements, that the possibilities of these combinations are ruled, for each language, by an ensemble of compatibilities and incompatibilities, and finally that the freedom of the discussion that is defined in certain of these rules is restricted in time to certain possibilities.

The emerging recognition of the distinction between *langue* and *parole* was reflected in the design of early computing, which seized on the mechanistic structures inherent in *langue* and the free and spontaneous character of *parole* to develop the capability of computing to calculate probabilities. For the first time in the history of human sciences, it had become possible to mirror the natural sciences in testing hypotheses empirically and in the laboratory. Saussure's assimilation of language to a strategic combinatory game enabled linguistics to reclaim immediately the game theory that was formulated in 1944 by John von Neumann and Oskar Morgenstern as a contribution to economics.

The mistake social sciences managed to overcome at this moment was to assume that mathematics is of interest because of its use in other disciplines, such as the physical sciences. Driven by such a comparison with the natural sciences, mathematics had been adopted as method to measure size. Population studies and psychology similarly relied on mobile quantitative scales to indirectly explain qualitative phenomena and thus reduced mathematization to two operations: to extract quantitative aspects from observations and then measure them with maximum precision. Yet this reliance on mathematics as method threw up a host of issues because the main difficulty for the human sciences was to specify the factors one can measure directly or indirectly, while at the same time alleging that they are the most important. Experimental psychology faced this conceptual error most acutely in that the least interesting things were most often also the most easily measurable. In short, the quantification of psychological and social phenomena did not correspond with their significance.

The conclusion to which human science in the 1950s had come was not, however, that the gulf between the natural sciences and the humanities is so great one should lose all hope of using natural scientific measures in the social sciences. Human sciences instead concluded that demographic economists and the experimental psychologists of the beginning of the century did not actually use mathematics sufficiently, as they relied on an outdated understanding of mathematics as method rather than as theory and philosophy. Lévi-Strauss argues that this *new mathematics*, which he calls the *human mathematics*, is often lost sight of by both mathematicians and social sciences. It wants to escape the hopelessness of big numbers, which reduces social sciences to an ocean of figures. Its domain is not the infinitesimal variations captured by vast data, but the small numbers that allow big structural changes to be observed.

This last point seems particularly prescient given what we know about the inclusion of mathematics in the social sciences over the remaining decades of the century, during which it was passed over when it was not used as method for quantification. The mathematics Lévi-Strauss had in mind crystalized in what he came to call "the canonical formula," an algorithmic system of interaction of elements, such as real numbers, and rules for their combination. Human mathematics he considered not to serve as a method of analysis, but as a means to give expression to properties of relations that pertain between qualitative sets of data that are seemingly incommensurable. By homing in on the properties of such relations, using philosophical and mathematical propositions of transformational sets or groups, anthropology was shown to be able to theorize the predictable and yet non-observable 'shape' of relations unfolding over time in the making of social worlds.

With the re-translation of Lévi-Strauss's (1962) classic work *La Pensee Sauvage* and the re-translation of "Les mathématiques de l'homme" (1956), we may be at the threshold of a reappraisal of modeling in anthropology, revisiting the art of calibration not as imposition on data but as drawing out an understanding and an imaginary, beyond the reach of institutions, brought to the complexity of relations. We will recall this argument being made by the mathematician Jack Morava's (2005) contribution to the edited volume *On the Order of Chaos* (Mosko and Damon 2005), in which he outlined the influence Lévi-Strauss's thinking had on the reappraisal of the direct observation of phenomena as scientific method. For anthropology, Morava reminds us that mathematics may indeed have had relevance all along, not as a method of quantification but as a conceptual tool to draw out the calibrations of complex relations between persons and persons and objects in "wild thought" (Lévi-Strauss 2021).

The question Lévi-Strauss raised in his essay is the epistemology of science. This is a question that came to a head in the late nineteenth century in the field of physics with a clash over the admissibility of sustained observation and intuitive understanding drawn from experience versus data drawn exclusively from experimentation. The unfolding discord and its ending, leading to a bifurcation of collections and institutions of academia into arts and natural science, is discussed by Isabelle Stengers (2011) in the Thermodynamics chapter of her *Cosmopolitics*. She recalls how theoretical physics proceeded with the work of thinkers that eroded the belief in the fundamental principles of thermodynamics based on the presupposition that matter is discrete and made of unobservable particles, allowing physics not just *not* to take observable phenomena into account but to discount them entirely. The invention of laboratory science is for Stengers far from a mere epistemological question, for "if phenomena can be subordinated," she explains, it is only "because those who are interested in them are themselves subordinate, left behind by revolutionary physics" (2011: 261). Stengers thus helps us to see why finding the right relation to mathematics was critical for human science to recuperate the model-building capabilities of a science of the concrete based on observable phenomena.

Why, we might ask, does the relation anthropology maintains with mathematics matter today? Anthropology has managed to stick to its guns building models based on observable phenomena, following Edmund Leach's (1961) suggestion that in order to generalize about social phenomena one should conceive of them in terms of the mathematical patterns they form. For Leach, the abstraction algebra offers was necessary if anthropology was to avoid merely describing one contingent case of social organization after another, to focus instead on the general laws that may underlie them (see also Daston and Galison 2007; Martin 2016). Leach's (1954) study of the *Political Systems of Highland Burma* made use of the Kachin's own operational and time-sensitive perceptions and practices surrounding their irrigation system, whose regular pattern of opening and closing informed their strategic understanding and approach to other matters. Leach was able to translate the properties of Kachin spatio-temporal practices into an abstract transformational model that could be applied to other contexts (Wallman 2016).

Anthropology, however, has not remained content with building models, but has set out to understand how models of complex processes are conceptualized and shared locally (cf. Glowczewski 1989; Rio 2005). A recent example of this is Hannah Knox's (2020) *Thinking Like a Climate*, in which she charts her informants' attempts to make the modeling of climate their own through artefacts, practices, and narratives that slowly and incrementally produce shared, locally grounded climate knowledge. Knox's ethnography is a tale of how her informants attend to mathematical objects that present themselves in the form of a variety of more or less technically sophisticated artefacts as part of a strategic localized approach to the complexity of climatic events. We might not think of this work as contributing to anthropology's approach to mathematics, but this may be a failure of anthropology's narrow conception of mathematics as a discipline abstracting from life rather than one that is able to come close to life and to ways of living with futures in mind (Guyer 2007).

Anthropology's problem arguably is that it has been overly concerned with the signifying potential of numbers, failing to ask how numbers maintain their power to signify (Maurer 2006). To this one can add that in assuming the signifying potential of numbers to be key to analysis, anthropology has tended to shun local practices of translating systemic (algebraic) relations between numbers into two- and three-dimensional assemblages of shapes of varying kinds and materialities (Holbraad 2020; Küchler 2017; Urton 2003), relegating these to the study of patterns. By not asking how this translation works and what it makes possible, anthropology missed out on a chance of 'indigenizing anthropology.' Barbara Glowczewski's study of the topological conception of relations underpinning kinship in Australian Aboriginal societies is a lesson on why the relation between ideas, mathematics, and complex realities is critical to local knowledge economies (1989, 2019). Decolonizing anthropology would be well advised to consider the re-thinking of the place of mathematics in social life and how it may enable us to re-envision the teaching and practicing of anthropology.

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# "The Mathematics of Man" by Claude Lévi-Strauss

*Translated by Matthew Carey*

## The Mathematics of Man[1]

When we examine the history of science, it is as if man set out, very early on, a fixed program of research, which then had to wait many centuries until he was capable of carrying it out. In the first days of scientific thought, Greek philosophers formulated the problems of physics in terms of atoms; twenty-five centuries later, we are just beginning to fill in the details of the framework they established, though we are doing so in ways that would undoubtedly have surprised them. The same is true of the application of mathematics to human affairs, for it was very much man, and not the physical world, who was the principal object of speculation for these early geometers and mathematicians. Pythagoras was deeply concerned with the anthropological meaning of numbers and forms; the same is true of Plato.

Over the past ten or so years, these ancient speculations have provoked new interest. Such interest is not restricted to the social sciences, but also embraces the humanities (if the two are, in fact, distinct entities). Indeed, I would go so far as to suggest that the humanities have very much led the way. Perhaps this was because the humanities appear, at first blush, to be so very estranged from any concern with rigor or measurement, but also because the essentially qualitative nature of their object prevented them, in contrast to the social sciences, from clinging to the coattails of traditional mathematics and forced them to turn instead to more audacious and innovative forms of mathematical reflection.

It is in the domain of linguistics that we can best trace the distinct steps of this shift and identify its fundamental character. Linguistics, in a sense, occupies a privileged position: on the one hand, it is a humanity, but its object is a social fact. For language does not merely imply social existence; it is its very foundation. What would be a society without language? Language is the most complete and most complex of the systems of communication of which social life is made, and which all the social sciences (each in their characteristic manner) set out to study.

Thus, we can say that any innovation within the field of linguistics has a topical value for both the social sciences and the humanities. Between 1870 and 1920, two fundamentally new ideas emerged within this field: the first under the impulsion of the Russian scholar, Beaudouin de Courtenay,[2] and the second driven by his Swiss counterpart, Saussure. The former suggested that language was composed of the discontinuous elements we call phonemes; and the latter demonstrated that linguistic analysis gives us access to systems—viz. sets governed by laws of internal coherence such that changes in one part of the set will provoke predictable changes in other parts. First identified in Russia by Troubetzkoy,[3] and further developed by his international successors (Jakobson, Benveniste, Sapir, Bloomsfield, Hjelmslev, Sommerfelt, and others), these principles gave rise to structural linguistics. This exploits discontinuities between those microscopic elements of language, phonemes (for whose discovery and definition we are indebted to Mediaeval Indian grammarians), in the first instance to identify these same phonemes, and from there to determine the laws of their reciprocal coexistence. These laws are every bit as rigorous as those we find in the exact and the natural sciences.

Meanwhile, independent laboratory research carried out by transmission engineers was to reach, around 1940, remarkably similar conclusions. Indeed we can recognize some of the grand interpretive principles formulated by theoretical linguistics in both speech synthesizers, like the famous *Voder* (the first in a line of ever-improving models), and in the theoretical formulations of intellectual method that prevail among communication specialists (first systematically presented by the mathematician and engineer Claude Shannon[4]). First, that human communication is based on the combination of ordered elements; second, that the combinatorial possibilities proper to each language are governed by a series of compatibilities and incompatibilities; and third, that discursive freedom, within the limits of these laws, is subject over time to certain probabilities. One memorable example of this confluence of ideas is the overlap between the famous Saussurean distinction between *langue* and *parole*, and the two principle directions taken by modern physics: Thus, *langue* is subject to mechanistic and structural interpretations, whilst *parole*, despite (or perhaps because of) its apparently free, spontaneous, and unpredictable nature, is subject to probabilistic calculation. For the first time in the history of the humanities it is possible, just as in the hard sciences, to devise laboratory experiments to test hypotheses.

Saussure also made a telling comparison between language and some strategy games, such as chess. This understanding, discussed above, of language as a kind of combinatory game allowed linguistics to seize on the emergence of game theory as formulated in 1944 by Neumann and Morgenstern.[5] The book, as its title suggests, was intended as a contribution to the field of economics. This unexpected confluence of ideas between a social and a human science underscores the fundamentally communicative nature of all human relations. The possibility of formalizing the linguistic exchange of messages and the economic exchange of goods and services in identical terms allowed us to perceive them as similar kinds of phenomena.

Finally, because discourse is always driven by the states that immediately preceded it, language can be seen as part of the fundamentally biological theory of servomechanisms that acquired notoriety under the name of cybernetics.[6] In a few short years, specialists from fields as distinct as biology, linguistics, economics, sociology, psychology, communication engineering, and mathematics have found themselves toiling shoulder to shoulder and with a shared conceptual apparatus that is gradually becoming their common language.

It is worth noting that this shift whose steps we are retracing continues apace. After the initial meeting of minds between linguists and engineers in the field of phonology (once again, the infrastructure of language), new independent developments have led the former to attempt a more rigorous formalization of grammar and vocabulary, whilst the technical problem of "machine translation"[7] has driven the latter to address the same questions. A few years ago, the English statistician Yule proposed a mathematical method of textual criticism.[8] Today, in certain religious circles (which have traditionally resisted the reduction of man to mere mechanics), people are eagerly applying mathematical method to the critical study of the gospels. An international congress of philology held in England in 1954 stressed the growing importance of mathematical techniques to philology, literary criticism, and stylistics. There are currently a handful of harbingers that suggest that the history of art and aesthetics (who have for long centuries dreamed of just such a possibility) might be about to witness a similar transformation.

When social scientists venture into the territory of mathematics, they can therefore find comfort, and indeed encouragement, in the idea that they are not alone in undertaking such risky endeavors. They are, to the contrary, riding the crest of a vast wave whose origins lie elsewhere. The faith social scientists have begun to place in mathematics is derived less from the results they themselves have obtained from the application of such methods, than from the immense contribution of mathematics to other domains of knowledge, in particular the natural sciences.

It is as well, however, to avoid confusion from the start by demonstrating the novelty of the particular confluence of ideas we have seen in recent years.

It is not, of course, only in the past ten years that social scientists have realized that a science can only truly be described as such when it can formulate a consequential series of propositions, and that the language of mathematics holds out the best hope of achieving such results. Psychology, economics, and demographics have long made use of mathematical reasoning. And though it is true that as regards psychology, the application of mathematics has been limited to psychometrics and experimental psychology (and even there has been subject to constant critique), the aspiration towards mathematical rigor and the application of mathematical techniques were present from the very beginnings of the other two disciplines and have been integral to their development. Should we then conclude that the only novelty lies in the extension of these well-established techniques to new disciplinary fields (sociology, social psychology, and anthropology)? This would be completely to misrecognize the nature of the current revolution.

The ends to which mathematics have been put in the social sciences over the past fifty years (and longer still in the case of economics and demographics) have always been quantitative. It has been a matter of measuring those variables in their respective fields that are susceptible to such techniques: population statistics, economics resources, salary mass, etc. And when, as in psychology, the observable data demonstrated no obviously quantitative characteristics, scientists proceeded indirectly by generating customized quantitative scales to measure forms of variation whose only directly observable aspects were qualitative: for instance the techniques used to reduce the varied manifestations of intelligence to a numerical IQ scale. The mathematical effort was thus limited to two kinds of operation: isolating the quantitative aspect of observations and then measuring it as precisely as possible.

This dual endeavor was perfectly legitimate in those contexts where the observable facts indeed demonstrated a quantitative character and this same quantitative character was the source of the knowledge generated. The whole point of demographics and economics is precisely to apply such methods. We desire quantitative data regarding numerical shifts in population, the increase or rarefaction of resources, etc. and there is no reason to suppose the disciplines that supply them will cease to develop analyses of this kind.

Yet even this highly restricted field presents certain difficulties. In order to extract the purely quantitative aspects of population phenomena, demographers must impoverish them. The populations they deal with bear only a tenuous relation to actual populations; they are composed of sexless individuals, indiscriminately endowed with a capacity to reproduce: dealing with couples would over-complicate the original question. Societies, for the demographer, are artificially homogenized sets, stripped of their most fundamental structural characteristics, such that whenever it is possible to observe a society in its entirety (as with the ethnographic study of typically small-scale entities), the actual behavior of the population proves to be very different from the demographers' abstract models. Such models only have value at vastly larger scales.

Economists face the same kind of problems. There too, quantitative analysis requires reality to be impoverished, disregarded, or deformed. Not that this is an easy task. Economic analysis often appeals to exogenous factors, which may at any given point destabilize the scale and nature of the predictions made. Yet these exogenous factors correspond to precisely those aspects of the data that the economist must disregard or minimize in order to treat them as quantities. The second part of the problem is that the extrapolations developed by economists rely on long series of observations and these series are always historical. This leads to a dilemma: one can either extend the series, whose constituent elements thereby become necessarily less comparable; or one can foreshorten it, thereby increasing its internal homogeneity, but also the margin of error of its predictions. In other words, precision of measurement is inversely correlated with the significance of results.

We are touching here on one of the essential problems of measurement in the social sciences. There are surely many things in our disciplines that can be measured, either directly or indirectly; but there is no guarantee that these are the things that matter. Experimental psychology, which has had a rather gung-ho approach to measurement, has been running up against this obstacle for years. Whereas in the natural sciences, the progress of measurement has been directly proportional to the progress of knowledge, as regards psychology, it has become clear that the phenomena most amenable to measurement are also the least interesting and that there is no relationship between the quantification of such psychological phenomena and their significance. This has led to an acute crisis in so-called "scientific" psychology; and as we have seen, this antinomy undoubtedly holds good (though perhaps to a lesser degree) in the other disciplines that have long aspired to mathematical rigor.

Should we then conclude that the differences between the exact and natural sciences, on the one hand, and the human and social sciences on the other, are so profound and irreducible that we should abandon all hope of extending to the latter the rigorous methods that have ensured the success of the former? Such a position (incidentally that of Friedrich Hayek)[9] is, we suggest, a form of obscurantism, in its etymological sense of obscuring as opposed to clarifying a problem. We should not reproach experimental psychologists of the early twentieth century, nor traditional demographers and economists, for having leant too heavily on mathematics, but rather for not having done so sufficiently . . . for only having borrowed the quantitative methods that mathematicians themselves regard as somewhat old-fashioned and *dépassé* . . . for not having noticed the birth and subsequent flourishing of a new mathematics—a mathematics we might almost describe as "qualitative," however paradoxical the term might appear, insofar as it introduces the notion that rigor and measurement are quite independent of one another. What we can learn from this new mathematics (that is merely establishing and developing ancient forms of speculation) is that the reign of necessity is not necessarily coterminous with that of quantity.

Here, we must beg the reader's indulgence as we relate the circumstances in which this distinction first became clear to us. Towards 1944, as we became progressively convinced that the rules of filiation and kinship were, *qua* rules of communication, not fundamentally different from those identified in linguistics, and thus amenable to a properly rigorous analysis, the mathematicians to whom we turned received us with disdain: marriage cannot be thought of as an act of addition or multiplication (and much less as subtraction or division), and thus cannot be formulated in mathematical terms. This continued until the day a young luminary of the new school, apprised of the problem, explained that there was no need to quantitatively reduce the rules of marriage in order to theorize them; nor even to know what marriage was. All that was required was to reduce the marriages observed in a given society to a finite number of classes, and that relations between these classes were determinate and stable (such that there is always the same relationship between the "class" of the brother's marriage and that of the sister, say, or between the "class" of the parent's marriage and that of the children). Once this is done, the marriage rules of a given society can be transformed into equations and analyzed using rigorous and established methods, while the actual nature of the phenomenon studied (viz. marriage) remains entirely bracketed out.[10]

As simple and summary as this example may be, it clearly illustrates the style of collaboration that mathematics and the humanities are now undertaking. The major stumbling block, in former times, was the qualitative nature of our research. To make our data susceptible to quantitative analysis, one either had to cheat or utterly to impoverish them. Today, however, there are numerous branches of mathematics (set theory, group theory, topology, etc.) whose goal is to identify rigorous relations between classes of entities separated by discontinuous values, and such discontinuity is precisely one of the essential properties of relations between qualitative sets, indeed is *the* property which determines their apparent "ineffability," "incommensurability," etc.

This human mathematics, whose locus remains a mystery for sociologists and mathematicians alike, and whose full maturity has yet to be reached, will in any case be quite different from that towards which social scientists of yesteryear turned in their desire to add rigor to their research. It aims to sidestep the despair of "large numbers"—that mortal raft adrift in a sea of figures to which the social sciences desperately cling; its ultimate goal is no longer to describe progressive and continuous shifts in monotonous curves. Its domain is not the infinitesimal variations thrown up by the analysis of big data. It focuses instead on *small* numbers and the *large* shifts provoked by the movement from one number to another. One might say that it is less concerned with the theoretical consequences of a ten percent increase in the population of a country of fifty million inhabitants, than with the structural transformations undergone when a couple (*ménage à deux*) becomes a "thruple" (*ménage à trois*). By studying the possibilities and the dependencies related to the number of participants in very small groups (which from this perspective remain "very small" even if the participants themselves are collectives numbering millions of individuals), we are reconnecting with a very ancient tradition: for the first Greek philosophers, the sages of China and India, and the indigenous thinkers of precolonial Africa and the pre-Columbian Americas were all concerned with the meaning, significance, and virtues of numbers. Indo-European civilization, for instance, had a predilection for the number three, whilst Africans and Americans thought in fours; and these choices have certain logico-mathematical consequences.

Be this as it may, the renewed attention to small numbers in modern thought was to have unforeseen consequences.

Precise evaluation of the impact of Neuman [sic] and Morgernstern's aforementioned work on the science of economics is, of course, best left to more qualified voices. That said, a sociologist or historian of ideas is perfectly entitled to try to understand the broader changes in mental attitudes brought about by new perspectives in economics, or indeed any other discipline. Until very recently economic analysis was based entirely on statistics and functional analysis. They worked with large numbers, long series of spatial and temporal variations, identified curves, and looked for correlations. Such analyses were, and remain, worthy of respect, as they allow for the prediction and prevention of certain undesirable correlations, and the maintenance and generation of other, desirable ones. Such speculation is useful, up to a point (though its real importance remains debatable), but it is frequently so abstract, and deals in such enormous sets of variables, that one can never be sure that the interpretation offered is the only possible one, nor the best (nor even whether it holds good); and even in the best hypothetical scenario, where lived experience entirely bears out the predictions, one can never really understand precisely what has happened, for none of us have ever encountered in our daily lives these abstract creatures of reason frequented by economists and named: marginal utility, profitability, productivity. . .

Yet, what do we find when we open *Theory of Games*? Well, first of all, a far more complex and sophisticated mathematical framework than in most economic, and even econometric, texts; and simultaneously, and somewhat paradoxically, we find that the objects of which it treats are far simpler. They are not abstract concepts, but people, and groups of people; and most of the time these groups have two, three or four members, rather like the groups formed when people play chess, bridge, or poker. What is more, these members are all engaged in activities that correspond to real experiences: they oppose one another or build alliances, conspire amongst themselves or against one another, they cooperate and take advantage of one another. In short, it is a style of economics that aspires to serious mathematical rigor and yet only focuses on concrete, real-world entities, endowed with immediate historical and psychological meaning.

Just what this new economics is really worth is a question for the specialists. We should merely like to note that it partakes of the two great streams of thought that have, heretofore, defined the science of economics: on the one-hand, an ostentatiously pure economics that assimilates *Homo oeconomicus* to a perfectly rational individual; and on the other, sociological and historical economics, as pioneered by Karl Marx, and which desires above all to be the dialectic of a struggle. These two aspects are equally present in von Neuman's [sic] theory. For the first time, then, bourgeois, capitalist economics and Marxist economics have a common language. Of course, this does not mean they will suddenly start agreeing on things; but at least dialogue is now possible between them and it was the mathematical method that allowed this startling turn of events.

A second example of this shift can be found in social psychology, more specifically in the work of Louis Guttman, exemplified in his monumental *American Soldier*[11] and, more recently, in *Mathematical Thinking in the Social Sciences*.[12] In the early days of the last world war, the American high command decided to call upon the services of huge numbers of social scientists to distil a little order and clarity into the social and psychological problems of recruitment and selection. But they ran into an early difficulty: how to attribute numerical values, in the interests of comparison, to the apparently heterogeneous answers given?

Whereas Lazarsfeld set out to apply probabilistic method to the task of identifying the objective basis of personality,[13] Guttman followed a quite different, and potentially revolutionary, path. He realized that numerical scales could be unproblematically applied in cases where the questions were drawn up and presented sequentially in increasing orders of magnitude. For instance, if in a questionnaire regarding height, we ask the following questions: “Are you taller than 5´2? than 5´4? than 5´6?” and so on, a respondent cannot answer the third question with a “yes” without also responding “yes” to the two previous ones (though not necessarily to subsequent questions). The numerical scales generated by such questionnaires are immediately identifiable as remarkably harmonious and regular. They intuitively render the clear logical and psychological structure of the questionnaires. Guttman’s innovation was to invert, so to speak, this relationship between the social sciences and mathematics. He demonstrated that even with questionnaires designed quite differently, whose psychological and logical structure is not known in advance, it is always possible to reorganize the responses to reach an ideal equilibrium. What is more, the techniques used to reach this equilibrium allowed, in turn, for the initial questionnaire to be systematically broken down into its logical and psychological components, such that an apparently purely formal treatment of the results of a given questionnaire became an instrument of critique, providing properly social scientific insights.

In his more recent work, Guttman has revisited some of the classic problems of social psychology, and in particular certain central themes in the thought of the early forerunners of the discipline (Spearman and Thurstone); in so doing, he has shed new light on psychological problems classically addressed via factor analysis.[14] This has opened up new perspectives on selection methods that rely on tests and on the theoretical interpretation of the role and value of such tests. At the same time, and without having explicitly set out to do so, Guttman has provided sociologists, historians, and anthropologists with a mathematical method that can be applied to the evolution and hierarchical analysis of human cultures—methods that may allow, for the first time, for a resolution of the difficulties and contradictions that have bedeviled and frustrated such research since the time of Condorcet and Comte.

We hope that these two examples, drawn from the fields of economics and social psychology, have helped illustrate the breadth and novelty of the changes that are currently reshaping the social sciences and humanities, influenced by the most recent developments in modern mathematical thought. There are, however, two serious problems.

The vast majority of social scientists working today received classical or empirical training. Very few can boast of a mathematical culture, and those who can are possessed of only a basic or conservative one. They will, therefore, need to make significant efforts to adapt if they are to make the most of the new perspectives opened up by certain lines of reflection in modern mathematics. A good example of such efforts was the extensive seminar in mathematics for social scientists organized by the American Social Science Research Council at Dartmouth College, New Hampshire, in the summer of 1953. Over eight weeks, six mathematicians presented the principles of set theory, group theory, and probability to an audience of forty-two social scientists.

It is to be hoped that such endeavors become more frequent and generalized, but they remain, nonetheless, makeshift, rear-guard actions. They will doubtless help the current crop of social scientists not to lose their footing entirely in the shifting sands of their disciplines, but we also need to consider the next generation, the teachers and researchers of tomorrow. Current social scientific cursi in higher education offer nothing in the way of mathematical culture. If the social sciences are to become true sciences (and, to be blunt, if they are still to exist in twenty years) then they require immediate reform. It is clear that the coming generation of social scientists will require a solid, modern mathematical education if they are not to be swept aside by the progress of science.

We are not, however, suggesting that the problem can simply be resolved by altering the training social scientists receive so they can benefit from the latest advances in mathematics. It is not simply a matter of borrowing methods and results from mathematics. On the contrary! The particular requirements and specific characteristics of the social sciences mean that mathematicians will need to adapt and innovate. Mathematics will contribute to the development of the social sciences, but the demands of the social sciences will open up new perspectives for the former. This is about developing new mathematics. Such cross-fertilization was, for two years, the aim of the seminar on mathematics in the human and social sciences held at UNESCO, in 1953–54, under the auspices of the International Council for the Social Sciences, and involving mathematicians, physicists, and biologists from the hard sciences and economists, psychologists, sociologists, historians, linguists, anthropologists, and psychoanalysts from the human and social ones. It is too soon to assess the outcomes of this bold experiment, but whatever its shortcomings may have been (and they are, of course, inevitable, when we are still blindly feeling our way), the participants were unanimous in declaring that the experience was an enriching one. For the innermost, intimate life of man is just as stymied by Chinese walls and exclusivity between intellectual domains as is his collective existence by mistrust and hostility. In working to unify distinct methods of thought, which cannot forever remain irreducible for their respective domains of knowledge, we ultimately contribute to the quest for inner harmony that is, perhaps, the true condition of wisdom.

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## Notes

1. This article first appeared in the *Bulletin international des Sciences sociales* (vol. VI, no. 4, pp. 643–653), edited by UNESCO, which has generously allowed for its reproduction here.
2. Translator's note: the correct spelling is "Baudoin" and he was Polish.
3. Troübetzkoy, *Grundzüge der Phonologie*, 1939.
4. Claude Shannon, "The Mathematical Theory of Communication," 1949.
5. *Theory of Games and Economic Behavior*.
6. N. Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine*, 1948.
7. A problem entirely absent from this particular translation [translator's note].
8. N. Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine*, 1948.
9. F. A. von Hayek, "Scientism and the Study of Society," 1952.
10. C. Lévi-Strauss, *Les structures* élémentaires *de la parenté*, 1949.
11. Texts compiled by S. A. Stouffer, 4 vol., 1949–1950.
12. Texts compiled by P. F. Lazarsfeld, 1954.
13. P. F. Lazarsfeld, "A Conceptual Introduction to Latent Structure Analysis." *Mathematical Thinking in the Social Sciences*, 1954, chapter 7.
14. Louis Guttman, "A New Approach to Factor Analysis: the Radex." *Mathematical Thinking in the Social Sciences*, chapter 6.