DAVID NIRENBERG *and*
RICARDO L. NIRENBERG

Numbers and Humanity

28

In the final weeks of World War I, Oswald Spengler published *Der Untergang des Abendlandes*, tamely translated as *The Decline of the West*. Its almost a thousand pages of turgid Teutonic prose swept over mangled Europe like a tidal wave, becoming the still-young century's best-seller. (A second volume was published in 1922, to less rapturous attention.) It offered a diagnosis to a world convulsed in mass-produced death, an explanation of the "last spiritual crisis that will involve all Europe and America." According to Spengler, the essence of modern civilization — its Faustian soul, he called it — was a type of mathematics that was created in the seventeenth century by Descartes, Galileo,

Leibniz, and Pascal. That mathematics had proven powerful but also lethal, for "formulas and laws spread rigidity over the face of nature, numbers make dead." Now the West and its mathematics, "having exhausted every inward possibility and fulfilled its destiny," were dying together.

Never mind that Spengler's claim about the death of mathematics was incorrect. From Mussolini to Thomas Mann, everybody who was anybody claimed to have read the book. Plenty of people disagreed with the analysis. In 1920, on the brink of winning the Nobel Prize, Albert Einstein wrote to the mathematical physicist Max Born: "Sometimes in the evening one likes to entertain one of his propositions, and in the morning smiles about it." He attributed Spengler's "whole monomania" to his "school-child mathematics." But the most acute critics recognized that Spengler represented a powerful stream of the *Zeitgeist* that saw in mathematics, as the writer Robert Musil put it, "the source of an evil intelligence that while making man the lord of the earth has also made him the slave of his machines." (Ulrich, the protagonist of Musil's great novel *The Man Without Qualities*, which was set in 1913 and published in 1930, is a mathematician, and his creator was himself a mathematically well-trained PhD.) Even the assassinations of that turbulent age were to be understood in mathematical terms. When Friedrich Adler murdered the prime minister of Austria in 1916, he invoked Einstein's mathematizations of the universe, which Adler interpreted as legitimating a shift of frames of reference from nation to class. The lawyers who pleaded in his defense, on the other hand, argued that the assassin was not in his right mind, because he suffered from "an excess of the mathematical."

Fast forward a century. We, too, live in an age in which the nature of knowledge is intensely political, and in which

the powers of number are rapidly expanding. Mathematical forms of knowledge — computation, artificial intelligence, and machine learning, for example — touch many more aspects of the world than they did in the first half of the twentieth century, or indeed, in any previous period of this planet's history. We stand on the threshold of new technologies — such as quantum computing — that promise to dwarf present powers of calculation. There is no realm of human life today exempted from quantification, a situation that one might think should constitute a crisis for our understanding of ourselves and our world. Yet very few people today would put the relationship of number and computation to other forms of knowledge anywhere near the top of the list of pressing questions confronting humanity, where we propose it belongs.

We, the authors of this essay, one of whom is a mathematician, are certainly not hostile to mathematics, whose insights have extended usefully into many aspects of the world. Nor do we agree with Oswald Spengler, or with Edmund Husserl, Martin Heidegger, and numerous other modern philosophers who have sought the origins of "the radical life crisis of European humanity" (the phrase is Husserl's) in some mistaken mathematical turn or other. The issue is not the legitimacy of mathematics, which is no issue at all. The issue is how we should think about both the powers and the limits of mathematics as we apply it to different realms of knowledge. We say powers and limits, because numbers have needs. The powers of mathematics depend on rules that do not apply to many things in the cosmos, from elementary particles to our own thoughts or mental states. The more we extend our mathematical reach toward those things, the more urgently we should all want to ask: what knowledge do we gain and what knowledge do we lose, and at what risk?

That question should be one of the most urgent of our era. To answer it, we need to understand the peculiar needs of numbers, and the problems that arise when those needs are not met. Alexander Craigie, the narrator of "Blue Tigers," one of Borges' last short stories, learned that lesson the hard way. A Scottish logician living around 1900 in Lahore, the fictional Craigie was moved by dreams of blue tigers to scour the sub-continent in search of the implausibly colored felines. What he found instead, in the sandy channels of a mysterious region that was taboo to the neighboring villagers and of the same distinctive blue as the tigers in his dreams, were disks: "identical, circular, very smooth and a few centimeters in diameter." He pocketed a handful and returned to his hut, where he removed some from his pocket. Opening his hand, he saw some thirty or forty disks, although he could have sworn that he had not taken more than ten from the channel. He could see that they had multiplied, so he put them in a pile and tried to count them one by one.

"This simple operation proved impossible." He would stare at any one of them, remove it with his thumb and index finger, and as soon as it was alone it was (they were?) many. "The obscene miracle" repeated itself over and over. The professor returned to Lahore. He carried out experiments, marking some with crosses, filing others, attempting to introduce some difference into their sameness by which he might distinguish them. He charted their increase and decrease, "trying to discover a law," but they changed their marks and their number in no discernable pattern. "The four operations of addition, subtraction, multiplication and division were impossible. The pebbles denied arithmetic and the calculus of probability... After a month I understood that the chaos was inescapable."

In this story, without theorems or technical notation, Borges set out in narrative a basic pre-condition for what is habitually called rationality, and posed a thought-experiment about what happens when that pre-condition does not hold. Logicians call that precondition the Identity Principle, which declares that for any thing, let us call it x, x is the same as x, or x = x. With certain things in certain circumstances, the Identity Principle works famously: a well-behaved pebble, for example, under moderate temperature and pressure, relatively short spans of time, and unaided human eyes, seems to have an identity consistent and unchanging, and can in good conscience be taken to be equal to itself. Moreover, when you put that pebble in the proximity of other pebbles there is no confusion; all of them conserve their identity. For other things, however, it does not work so well. In the case of blue tigers it did not work at all. None of them could be identified as having an identity that remains the same as itself. Hence they could not be grasped by counting, by statistics, or any logical or scientific analysis.

Not only are blue tigers ungraspable, but according to Borges they are also maddening. At the brink of insanity, at that hour of dawn when "light has not yet revealed color," Craigie enters the mosque of Wazir Khan. He prays to God for relief. Suddenly a blind beggar appears before him and Craigie gives him the disks. The beggar's responds: "I do not yet know the nature of the alms you have given me, but mine to you are terrible. Yours are the days and the nights, sanity, habits, and the world."

Borges' conclusion seems to imply that we must choose between two types of attention, two forms of life, two kinds of knowledge, each horrifying in its own way. On one side, the ever-changing, indistinguishable, and uncountable "blue

disks," bringing unreason, chaos, madness; on the other, stable pebbles, countable because unchanging, always the same as themselves, bringing reason, science, and sanity. Writing in 1959, C.P. Snow famously deplored what he saw as the deepening division between the humanities and the sciences as "the two cultures." In the logician and the beggar, Borges gives us a related but more fundamental and deeper division between cultures, one committed to the rule of the Principle of Identity, the other committed to its absence.

Borges' story is another example of his extraordinary ability to dress epistemology in fiction, but its conclusion is misleading. The world does not divide cleanly between "blue tigers" and normal pebbles, nor between insanity and reason. There are infinitely many objects of thought in this world that act like well-behaved pebbles, but there are also infinitely many that act like the ones that Craigie found on the forbidden path. In fact, with the exception of the very peculiar objects of logic and mathematics, every "normal" pebble is also from some perspective a "blue tiger." Our challenge as humans in the world is not that of giving away one or the other, but of becoming conscious of why in a particular instance or for a particular need we have favored one over the other, and of what we may have gained or lost in doing so.

Take number as an example of those peculiar mathematical objects whose "eternal sameness" can indeed be established through axioms and proof. Even in the case of number, the task is not easy; it took many steps and was not fully accomplished until shortly after the publication of Spengler's books, with the appearance in the 1920s of two articles by John von Neumann on the axiomatization of set theory. Von Neumann would accomplish many things, ranging from the Hilbert space formulation of quantum mechanics and the

creation of game theory to the logics for computer programming and the conceptualization of the hydrogen bomb. But his insight in these two essays was equally dazzling. He proved that with only one object that is always and utterly the same as itself, one operation upon that object, and an elegant handful of axioms, you can establish firm foundations of sameness and strict identity for the vast edifice of mathematics.

That object is the empty set, ø, and the operation take-the-set-of, {}. A set is a collection of elements. For example, the set of letters of the word "myth" is {h, m, t, y}. The empty set ø, however, is the set containing nothing. Because ø contains nothing, we can be certain that it never changes: ø = ø always. The same is true of all sets containing only combinations of ø and {}, such as {ø}, or {{ø}}, or {ø, {ø}}, *ad infinitum*. We may not say as much of the set {h, m, t, y}, for its elements might vary depending on culture and language — h in English is different from h in Spanish, or from h in French; there are several different h's in Proto-Indo-European, and in Russian h does not exist. But ø, *mirabile cogitatu*, never changes, it is universal. With ø as the only brick, von Neumann showed that all numbers (and countless other mathematical objects) could be derived, an edifice of eternity. And in case you doubt that existence, logicians and mathematicians can set your mind at ease: ø exists because we say so. It is a rule of the game, an axiom.

Yet the important point, for our purposes, is that ø and purely mathematical objects are the exception. Of everything else in the world we can say that there is no absolute foundation of sameness, no thing that can be said with certainty to remain strictly the same as itself as it interacts with the world. Even a "normal" pebble strung in an abacus is constantly undergoing change, though that change may not be relevant to the particular use to which we are putting it. No one has yet

discovered strict and absolute sameness in the physical world, even at the most basic levels of the universe. Describing the difficulty of determining the sameness of a given electron, proton, or other quantum object in 1952, the pioneering quantum physicist Erwin Schrödinger sounds much like Craigie trying to count blue disks: "This means *much more* than that the particles or corpuscles are all *alike*. It means that you must not even *imagine* any one of them to be *marked* — 'by a red spot' so that you could recognize it later as the *same*." And he continues: "If you happen to get 1000 [or] more records of a proton, as you often do, then notwithstanding the greatest psychological urge to say: it is the *same* proton, you must remain aware, that there is no absolute meaning in this statement. There is a *continuous* transition between cases where the sameness obtrudes itself to such where it is *obviously* meaningless." (Emphasis in original.)

Apart from purely mathematical objects, everything in the world acts to some degree or from some perspective like a "blue tiger." But conversely, many "blue" objects can be treated *as if* they were stable, *as if* they remained the same, as not only physicists but also economists, psychologists, and indeed all of us demonstrate every day. The continuity of daily life, its legibility, depends upon our countless unspoken postulation of such sameness. Our sciences also depend upon such postulations, but in their case it is important that these not remain unspoken, lest we build our knowledge on foundations whose load-bearing capacity we do not comprehend. Von Neumann again provides a marvelous example, both of the power of sameness and its axioms, and of the need to cultivate an

awareness of the limits of that power. His *Theory of Games and Economic Behavior,* which appeared in 1944, co-authored with Oskar Morgenstern, was a massive attempt to build a foundation for human behavior upon the same object that he had used for mathematics: the empty set. "We hope to establish satisfactorily...that the typical problems of economic behavior become strictly identical with the mathematical notions."

Strictly identical! That is a shockingly hubristic claim. Let us dwell for a moment on what it means. If you assume, as von Neumann and Morgenstern did, that the behavior of economies is built out of the desires and the choices of individuals, then establishing "strict identity" means demonstrating that "the motives of the individual" — that is to say, psychology — are reducible to "the mathematical notions." This is what von Neumann and Morgenstern set out to do. Invoking the example of physics, they began by creating a radically simplified model, an economy of just one isolated individual. Following a tradition already established by Marx and other economists, they named this single-actor economy after the famous literary castaway Robinson Crusoe. They then set out to describe the "assumptions that have to be made" about "the behavior of the individual, and the simplest forms of exchange." The first assumption or axiom was that the individual seeks to "obtain a maximum of utility or satisfaction" of his various desires and wants, within the given constraints.

But how do we know that the maximization of utility is a universal law of human nature? There are some who have doubted the proposition. But let us grant this initial assumption, for the sake of argument, and move on to the next. In order to be maximized, "utility or satisfaction" must be quantifiable, or at least rankable. Why should we think that desires

are quantifiable or rankable, either by human agents or by economists studying them? It would appear that this assumption about the quantification of human desires is neither empirical nor psychological. The assumption is necessary only so that economics can become a mathematical science, much as in physics time needs to be thought of as the real number line, not because this corresponds to our experience, but because aspects of modern physics would otherwise be difficult, if not impossible.

To put their assumptions in more formal terms: given any two objects of desire *u* and *v*, the subject can always say which one she prefers, or else that she is indifferent, i.e., that she has no preference for either *u* or *v*. But what about when there are more than two options on the table, as there so often are? For that we need yet another axiom: for any three or more commodities, objects, or imagined events — call them *a, b, c*... — all rational agents who prefer *a* to *b* and *b* to *c* will also prefer *a* to *c*. This crucial assumption, called the "transitivity of preference," is axiom 3:A:b in von Neumann's and Morgenstern's *Theory of Games and Economic Behavior*. The justification? "Transitivity of preference [is] a plausible and generally accepted property." That does not seem to us a sufficiently examined justification for such a crucial axiom. But with these axioms in hand, they proclaim "that it is possible to describe and discuss mathematically human actions in which the main emphasis lies on the psychological side." Describe and discuss? Sounds reasonable enough. But they go further: "a primarily psychological group of phenomena has been axiomatized."

The phrase exhibits its hubris in sequins and *faux fur*. At this point we should insist again that we are not critics of mathematics, or even of its application to the study of human behavior. These are powerful tools that, for good and ill, have

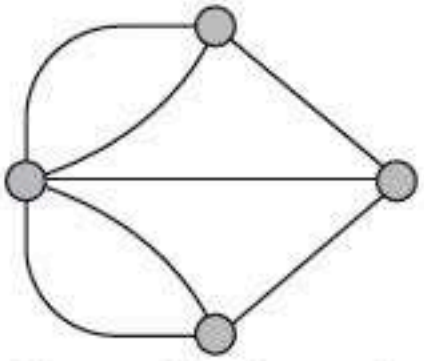
had a vast and often salutary impact upon human knowledge and (not only human) life. But in making questions of human desire strictly identical to mathematical notions, von Neumann and Morgenstern have forgotten a basic truth and omitted a basic question. In the words of Charles Sanders Peirce, an earlier logician and philosopher of astounding talent:

> An engineer, or a business company... or a physicist, finds it suits his purpose to ascertain what the necessary consequences of possible facts would be; but the facts are so complicated that he cannot deal with them in his usual way. He calls upon a mathematician and states the question. ... It frequently happens that the facts, as stated, are insufficient to answer the question that is put. Accordingly, the first business of the mathematician, often a most difficult task, is to frame another simpler but quite fictitious problem... which shall be within his powers, while at the same time it is sufficiently like the problem set before him to answer, well or ill, as a substitute for it.

The basic truth of which Peirce wisely reminds us is that every mathematical thematicization of objects that are in any way blue is a simplification, a similitude, an "as if." And the basic questions that von Neumann and Morgenstern chose to ignore, but we insist should never be forgotten, are: how "sufficiently like" is the similitude to the object of study? And how do we decide if the difference is for well or ill? A great deal hinges on the answers to those questions.

Our answers to them will always be relative to what it is we want to know about. Consider the famous mathematical simplification undertaken in 1736 by Leonhard Euler in his

"Seven Bridges of Königsberg" problem. The problem requires one to determine if a dry path can be found across a landscape of four land masses separated by rivers, with the constraint of crossing each of the seven available bridges only once. Euler approached the problem by eliminating every feature of the landscape, retaining only an abstract representation of each land mass and each bridge, treating the former as a node, or vertex, and the latter as an abstract connection, or "edge." The entire landscape, the width of its rivers and the size of its forests, the height of the hills and fertility of the fields, are reduced to a graph that consists only of nodes and edges:



It turns out that by counting the number of edges touching each node one can determine if the trip is possible. (Those who want to learn how may turn to Wikipedia.) The simplification is powerful and meets the needs of the particular problem, as well as many others: hence it inspired fields such as graph theory, topology, and the theory of networks. But there are many questions that we may ask about the navigability of the same terrain, and many of them will not be answered by the identification of nodes and edges. For example, where to find a forest in which to paint. For the answer to that question, one might prefer a very different kind of simplification, such as a map. And for the painter seeking verdant inspiration, only the forest itself will do.

So let us return to Morgenstern's and von Neumann's notion of "transitive man" and their axiomatized "Robinson Crusoe." Is that simplification adequate for the psychological description it purports to provide? For the two modern Central European scientists, it certainly was. For Daniel Defoe, the author of *Robinson Crusoe*, published in 1719, it most definitely was not. From beginning to end, the book's eponymous hero is best described as un-axiomatizable because self-contradictory, a weathervane, unable to order, to maintain, or even to recognize his preferences. Years of shipwrecked self-reflection on his desert island do not erase the fluctuating nature of Crusoe's desires and aversions. Quite the opposite: they heighten his awareness of his inner flux, as here, near the end of the novel:

> From this moment I began to conclude in my mind that it was possible for me to be more happy in this forsaken, solitary condition than it was probable I should ever have been in any other particular state in the world; and with this thought I was going to give thanks to God for bringing me to this place. I know not what it was, but something shocked my mind at that thought, and I durst not speak the words. "How canst thou become such a hypocrite," said I, even audibly, "to pretend to be thankful for a condition which, however thou mayest endeavour to be contented with, thou wouldst rather pray heartily to be delivered from?"

This literary moment feels familiar and true to our experience: a moment in which one suddenly becomes aware of the inadequacy, the contradiction, the inconstancy, even the untruthfulness, of one's own convictions about one's

happiness. Such insights about conflicts, competing desires, and even contradictions within ourselves amount to a kind of knowledge that literature and the arts often confer, and indeed often make into their very subject. And one of the innumerable lessons that we can draw from such humanistic knowledge is this: in so many important aspects of his thoughts, desires, and being, Defoe's Robinson Crusoe is not von Neumann and Morgenstern's transitive man, and neither are we.

And what about Pierce's "well or ill"? How do we judge that? In this case we could choose the standard that von Neumann and Morgenstern themselves set. Neither their theory of human behavior, nor the field of economics, nor indeed any of the social sciences, have achieved anything like the powers of prediction to which they aspired. What von Neumann and Morgenstern hoped for was to attach the predictive power of mathematics, so effective in the physical world, to the realm of the social and the psychological. Yet nothing like such power has yet been delivered by the quantifications and the models of the social sciences. But that is not a sufficient judgement. We also need to ask about the more general consequences of reducing "blue" aspects of the human to the Principle of Identity. For example, much of the political and economic machinery of the modern world is founded on the assumption that we know what we desire for our happiness, and the maximized fulfillment of those wants is the aspirational "good" that authorizes our political life in modern democracies.

This "'economic' point of view," as Freud called it, underpins an enormous amount of theorizing about human

behavior. Hence, we have designed systems and sciences that define and measure "the good" as the freedom to translate certain of our desires into political and consumer choices. But what if the dynamics of our psychic lives are quite otherwise? What if (to quote Freud again) "the logical laws of thought do not apply" to the psyche? If our social sciences have not yet truly interrogated the nature of our desires and of our happiness — or worse, if they have built themselves on mathematical foundations that confuse that nature — then this machinery is spinning dangerously dogmatic wheels, at we know not what risk to our humanity and our planet. This danger cannot be countered simply by more and better mathematization, as the advocates of *homo economicus* sometimes imagine. If human nature is not reducible to the Principle of Identity, if essential aspects of our being are irreducibly "blue," then it is only by learning to recognize the limits of mathematization, and to cultivate more azure forms of knowledge, that we can understand the human world with humanity.

Becoming conscious of how and why we apply mathematics to the world, and of asking about the "well or ill," about what we gain and what we lose through such applications: this is a genuinely important task. But it is a difficult one, because on these issues our tendencies are so often bipolar, just as they were in Spengler's age. The tendency to separate mathematics, logic, and science from poetry, imagination, community, and philosophical-spiritual life must rank among the most important and enduring of modernity's culture wars. Perhaps this is what John Dewey meant a century ago when he lamented that "this present separation of science and art, this division of life into prose and poetry, is an unnatural divorce of the spirit." In an essay on poetry and philosophy, Dewey

concluded with the imperative: "We must bridge this gap of poetry from science. We must heal this unnatural wound."

We have already glimpsed the beginning of a bridge and a balm: the anti-Manichaean recognition that, from physics to psychology to poetry, all objects of our thought are in some ways subject to logical principles such as identity and in some ways not. From such a more inclusive and tolerant position we could begin to examine what mathematics can offer to the study of the human and what it cannot, or what physics and poetry might or might not have in common. The challenge is great because the dualism runs deep, excavated on both sides of the divide. An aphorism attributed to the physicist Lord Kelvin, a version of which was inscribed circa 1930 on the façade of the Social Science Research Building at the University of Chicago, represents one side of the chasm: "When you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind." On the other we can array philosophers such as Henri Bergson and Martin Heidegger or poets such as Aimé Césaire, for whom "scientific thought counts, measures, classifies, and kills" (the words are from Césaire's *Poésie et connaissance* of 1941, but we could multiply references). Both dogmatisms are dangerous, though their power may not be symmetrical. In our universities today, it feels as if Lord Kelvin is chasing poetry from the field.

The "knowledge wars" of our present moment offer a special challenge because the political valences of the available positions are changing. In the 1980s and 1990s the power of science seemed the greater danger to humanities professors. Foucauldian critiques of the politics of knowledge and the constructedness of science were their preferred antidote, while the right parodied deconstruction and the relativization of science as the delusion of leftist

scholars. Today academics feel the greater danger emanating from the denials of science and are more prone to stress facticity, while the *Wall Street Journal* runs editorials decrying climate science and COVID epidemiology as "political." This may therefore seem like an odd moment in which to call for reflection upon the limits as well as the powers of number, or to advocate a remembrance of the essential "blueness" of the world and a rapprochement between forms of knowledge such as "physics" and "poetry."

But politics is a poor compass for critical thought. Besides, one can defend science without falling into scientism. The defense of vaccination and environmental regulation does not require a belief that the only valid questions in the study of human life, and the only valid answers, are "countable" ones. Moreover, there has never been a perfect moment in which to call for a recognition of the limits of the mathematical and a recollection of the importance of the non-mathematical. Pythagoras was declaring the eternal virtues of number already in the sixth century BC, while Heraclitus denounced him as a "swindler in chief." The thirteenth century poet Henri d'Andeli mocked the battles between the faculties of Paris, who were adepts of logic, and those of Orléans, who favored ancient literature.

> Do you know the reason for the discord?
> It is because they differ about learning;
> For Logic, who is always wrangling,
> Calls the authors authorlings.

There has never been a perfect moment, but reflection is more necessary now than ever, if we wish to preserve our worlds.

As these citations make clear, great minds have dedicated centuries of attention to these questions. Among the products of that reflection are the dualisms and the exclusivisms that we have just decried. We do not pretend to have solved these problems, but we do want to propose an exercise in "consciousness raising" that can help us develop an ethics of knowledge with which to navigate the dangers of civil war between the sciences of number and the knowledge of humanity.

For a start, we must recognize the irreducible "blueness" of any non-purely logical or mathematical things that we want to know about, and accept that mathematical tools applied to those things offer simplified similitudes. Then we can ask, how good is the similitude? What purpose did we want it for? What did we gain and what did we lose with the simplification? For "well or ill," and from what perspective?

The wondrous predictive power of mathematical models comes from their ability to identify, abstract, idealize, and simplify: to leave things out. In justifying their "Robinson Crusoe" method, von Neumann and Morgenstern pointed out that Galileo ignored wind currents and viscosity in his model of free-fall. If he had chosen to focus on turbulence, as James Clerk Maxwell once quipped, modern physics might not have gotten off the ground. But what can safely be left out and what cannot? That question confronts anyone who seeks to reduce non-mathematical objects to mathematical models. When the object is the human psyche, the question is very difficult indeed, and repeated applications of the Principle of Identity will likely retard our quest for knowledge as much as advance it.

The famous "replication crisis" in psychology, the modern science dedicated to the study of the psyche, is only one

symptom of the difficulty. The crisis consists of the increasingly apparent fact that the majority of experiments in the field, when repeated, do not yield the statistically significant findings reported in the original. In the social as in the natural sciences, the repeatability of an experiment — getting the same result from the same or similar experiment — is a pre-condition for accepting its results as true. Why is repeatability so low in the discipline of psychology and other social sciences? Multiple explanations have been offered, from deliberately faulty research practices such as p-hacking (the manipulation of data analysis to find statistically significant patterns) to individual and communal biases (publication bias, selection bias, confirmation bias, etc.).

A more fundamental explanation was already offered in 1843 by Kierkegaard, in a book he entitled *Repetition, A Venture in Experimenting Psychology*, whose authorship he attributed to a scholar he called Constantin Constantius. (The name already expresses a prejudice for the Identity Principle.) Constantius set out in search of repetition, a quest that is presented as ludicrous from the start. He traveled to Berlin, where he went to see a farce starring a famous comic actor. In his theater box he was suddenly transported. He describes himself lying on the floor laughing his head off, just as he had as a boy, lying by the foaming stream at his father's farm. Still, he adds in conclusion, he lacked something. What he lacked, it turns out, was a pretty girl to watch. He looks around and finds one, but fails to recognize his own experience, the repetition of his happy childhood at his father's farm. To stuff the farce to the top, back in Copenhagen he decides to return to Berlin to see if he can replicate his exhilarating experience at the same theater with the same actor. He fails, and therefore concludes that in human existence there is no repetition.

Kierkegaard's "venture in experimenting psychology" is a precocious critique of repeatable experimentation in psychology. Literary works such as Proust's *Recherche* and Borges' "A New Refutation of Time" offer a related critique. In those works a person undergoes the experience of being suddenly and involuntarily transported to his past. It is not a memory, a remembrance. It is that moment of one's past relived. It is the same moment yet different, for when the moment is relived, the person remembers having lived it once before, and much that happened in between. If the person reflects on what that experience may tell them about their notion of time, they should not conclude, as Borges did, that time is thereby negated or refuted, but rather that time can have loops, that it can curl back towards itself, cross itself, and then go on. In mathematics, such crossing points are called "singularities," a technical word that, in our context, acquires poetic and ontological harmonies. For the experience of repetition changes the experiencer.

When it comes to human experience, in sum, repetition is a tricky notion. In simple cases, or if we get the simplifications right, there are certainly aspects of the human psyche that can be approached through repeatable experiment, counted, measured, and expressed in mathematical terms. We do not mean to detract from what such findings can teach us. But those aspects will not only be very simplified: they will also omit much of what we care most about. The problem is not that, as one recent study put it, "psychological research is, on average, afflicted with low statistical power." The more fundamental issue is that much that is human cannot be subjected to the Principle of Identity, nor to the other logical "laws of thought" upon which the more mathematicising branches of academic psychology depend. Can so much be

safely left out of what counts as knowledge about ourselves?

The Polish writer Olga Tokarczuk, who won the Nobel Prize in literature in 2018, described her own experience of studying psychology in Warsaw. "We were taught that ...in its essence the world was inert and dead, governed by fairly simple laws that needed to be explained and made public — if possible with the aid of diagrams." From all of this she drew a simple lesson: "steer clear of psychology altogether. ...The psyche is quite a tenuous object of study." That, presumably, is why she transferred her own efforts from the scientific to the literary. But the literary is also subjected to number nowadays, as universities increasingly orient their humanities toward the digital in their quest for relevance, resources, and recognition as "knowledge." The "digital humanities" represent the deepest penetration of the mentality of quantification into humanistic study, and its premises must be critically scrutinized. Here again we need to ask: how "like" is the mathematical simplification to what we want to know? And what is lost or gained in the simplifying?

With regard to the first question, we happily adduce a recent and remarkable article by Nan Z. Da, in which she makes "The Computational Case Against Computational Literary Studies." "In a nutshell," she writes,

> the problem with computational literary analysis as it stands is that what is robust is obvious (in the empirical sense) and what is not obvious is not robust, a situation not easily overcome given the nature of literary data and the nature of statistical inquiry. There is a fundamental mismatch between the statistical tools that are used and the objects to which they are applied.

We will not go through the various problems that Da identifies and the various examples that she picks out (though what she does with a Chinese translation of Augustine's *Confessions* is quite breathtaking). Instead we wish to stress her conclusion, framing it in our Peircean terms. Applications of textual "data mining involve a trade-off: speed for accuracy, coverage for nuance." When well designed, the resulting similitude is good enough to give us a "simple piece of information that is either actionable or that can be quickly labelled and classified along simple features." But this simplification "always involves a significant loss of information. The question is whether that loss of information matters."

Again, the answer to that question will depend on what we actually want to know. For certain industries, questions, and masses of data that no one could possibly read or want to read, such computational methods may meet specific needs. But if what we want to know about is our own potential for reading and for meaning, our own engagements with language and how those engagements can shape or transform us, then the loss is enormous, since it amounts to much of the relevant complexity. The danger, we repeat, does not lie in number, mathematics, or computation. The danger lies in our tendency to ask of these more than they can provide. Perhaps this too is an attribute of our humanity: a yearning for stability at the foundations, a prejudice for calling knowledge only that which approximates certainty, a preference for simplicity in explanation, a desire to banish the uncountable — the "blue tigers" that fill our pockets and our world — to some blind beggar, magical realm, or marginal humanities discipline. If so, then it is all the more necessary that we become aware of that aspect of our humanity, rather than repress it for the sake of uncertain numerical certain-

ties. Today the task seems all the more urgent, not only for scientists and professors of the humanities but for all of us human inhabitants of the Anthropocene.