Algorithmic Divination: From Prediction to Preemption of the Future

CHRISTOPHE LAZARO

ABSTRACT:
Predictive algorithms today share more than just semantics with the divinatory practices of the past. This article will map the parallels, contending that the similarities between the two practices are true "propositions" that radically question the way we apprehend the world, the way we draw our knowledge from it, and the way we then act within and upon it. Mindful of the limitations of such a comparative method, it will nevertheless attempt it by deploying a twofold approach. On the one hand, the article questions the epistemological nature of predictive analytics and examine their truth claims with regard to how they represent the future. On the other hand, it focuses on the ontological dimension of predictive analytics and investigates how they shape the world by bringing about the presence of the future in the here and now.

KEYWORDS:
divination, algorithmic prediction, preemption, anthropology, big data, future, rationality, Cicero

THE SPECTACULAR DEVELOPMENT AND PROLIFERATION of algorithmic systems capable of collecting and processing massive quantities of data have arguably conferred new devices of prediction on humans. These devices allow us to anticipate risks, optimize decision-making processes, and exercise control over others in fields as diverse as security, insurance, marketing, and entertainment. In the era of big data and profiling, various applications make it now possible to predict and above all preempt behaviors by structuring the possible scope of individuals' actions.

Whether based on forms of statistical modeling or more recent forms of machine learning, predictive algorithmic systems are more than ever nurturing the belief in the ability to grasp the future and cope with life's uncertainty. This belief is reinforced by the emergence of an anthropomorphic trope praising both the autonomy of algorithms and the intelligence of data. Whether they come from the field of hard or social sciences, from the journalistic or political sphere, the discourses feeding this trope all share a common semantics of prediction, divination, or even magic.

According to a wide variety of actors, algorithms are the oracles of contemporary societies:

> The modern oracles of our networked digital age are Big Data and data analytics. Data gatherers such as Google and Amazon survey the world, create personality profiles and comb through huge volumes of data at lightning speed for patterns and correlations, allowing them to make predictions in real time. They provide a targeted look into the crystal ball. States, research institutions and commercial companies hope that they can provide accurate predictions to minimise the risk of their own actions and to better assess the opportunities for future activities. It is also about making structured use of the knowledge in organisations.[1]

Christophe Lazaro is a law and society professor at the Faculty of Law and Criminology of the Université Catholique de Louvain, Belgium.

Information & Culture, Vol. 58, no. 2, 2023

DOI: 10.7560/IC58202

The use of this semantics of prediction or divination—a semantics that refers to a type of "apparently irrational beliefs"—is far from trivial.[2] The references made to prediction or divination are not merely stylistic; instead, they are, I contend, true "propositions" that radically question the way we apprehend the world, the way we draw our knowledge from it, and the way we then act within and upon it.

Of course, the desire to know the future has haunted the minds of humans since the dawn of time.[3] The human being has always sought to discover what the future holds by invoking spirits or gods and asking them for signs: Will the hunt be good? Will the harvests be abundant? Should we go to war? Will it be a happy marriage? This desire to foresee or predict the future was an individual as well as a collective matter, whether at the scale of the village or the empire. The future has thus always been an object of political knowledge and action.

Drawing a parallel with the divinatory practices of classical antiquity, this article sheds light on contemporary beliefs in the predictive power of algorithms by deploying a twofold approach. On the one hand, it questions the epistemological nature of predictive analytics and examines their truth claims with regard to how they represent the future. On the other hand, it focuses on the ontological dimension of predictive analytics and investigates how they shape the world by bringing about the presence of the future in the here and now.

ARTIFICIAL DIVINATION AND PREDICTIVE ALGORITHMS

Methodological Remarks

From a methodological point of view, drawing a comparison between predictive algorithms and divination is anything but easy. Like any attempt of this sort, it can be fruitful, but it can also reveal certain methodological limitations. In our approach, these limitations are mainly due to the extent of the investigated field. Indeed, the study of divinatory practices embraces a very broad area both in space and in time because of the expansion of these practices around the globe and their longevity throughout history.

There is such a wide variety of practices spread over various geographical areas that it is difficult to place them under a common denominator without losing ethnographic thickness. Nevertheless, beyond the multiplicity and contingency of the techniques used, it is the very idea of producing knowledge that goes beyond human comprehension and that can reveal the future that needs to be questioned. More specifically, it is the idea of "artificial divination" based on the interpretation of signs that this article explores further because it echoes contemporary prediction modes based on the algorithmic processing of signals and traces circulating in digital networks.

Conventionally, scholars distinguish between two kinds of divination: the first, called "artificial" or "inductive," which pertains to art, to what the Greeks call a τέχνη (*technē*); and the second, called "inspired," "natural," or "spontaneous," which does not resort to any technical skill. Such a distinction, apparently, was made early on by the Greeks and may even have been known by Homer, who in *The Odyssey* lists divination as a craft alongside carpentry and medicine.[4] Within the Roman world, Cicero made explicit use of it in his book *De divinatione*.[5] Since then, this distinction has been taken up by many authors, including Auguste Bouché-Leclercq in his famous *Histoire de la divination dans l'antiquité*.[6]

Artificial divination includes techniques based on the observation of signs or conjecture, such as haruspices, omens, predictions from lightning and wonders, and so on. It

is important here to distinguish two situations: either the sign is already known and has been listed, or the diviner who does not know its meaning can then find it in the divinatory books, where the observations made over the centuries are recorded. In Cicero's time, those books were, for instance, the *libri Etrusci* and the *libri augurales*.[7] Or the sign is unpublished and has never been recorded in any book; the diviner will then give a personal interpretation by deploying his art of conjecture. Natural divination instead consists of a direct communication with the divinity, as in the case of oracles, premonitory dreams, or delusions, and somehow involves the eclipse of reason (a kind of delirium deriving from a possession by some divinity who comes into contact with diviners, sibyls, or Pythian priestesses). It should be noted, however, that technique or art is not completely absent from this second form of divination either. Indeed, spirits or gods often convey their messages in a very ambiguous, if not obscure, manner, and it is therefore necessary to resort to interpretation, which is a matter not of nature but of art. We will return to this aspect later on when reflecting on the opacity of algorithmic systems.

The reference to Greco-Latin divination also marks our methodological choice to limit the investigation to an intellectual and political space and time with which the Western scientist or layman has a certain form of familiarity. Beyond this relative familiarity, the focus on classical antiquity—more precisely, on Cicero's treatise on divination—makes it easier to clarify the rationalities that are intrinsic to operations on signs or data. It should be noted that this work by Cicero (dating from 44 BC) is particularly rich for our analysis because it deals with different practices used by the Greeks, the Latins, and other peoples. In Cicero's time, the divinatory landscape was vast and complex. Several practices—both official and private—existed side by side, such as the consultation of auspices by augurs and magistrates, the haruspices inherited from the Etruscans, and the astrology of the Chaldeans.[8]

In that respect, I will show that the current criticisms addressed at predictive algorithms are strongly reminiscent of those that, during Greco-Latin antiquity, were formulated against mantic and divinatory practices by the first representatives of an emerging science. Moreover, Cicero's skepticism regarding divinatory practices also echoes the famous debate about the "rationality" of indigenous beliefs that has caused rivers of ink to flow in the field of anthropology.[9] It is as if today one needs once again to replay the epistemological and ontological match opposing rational and irrational, primitive and modern, analogic and causal thinking by questioning the illogical part of scientific constructions, as well as the pragmatic and immanent logics of nonscientific conceptions of the world.

Through a cross-examination of the divinatory practices of antique and contemporary algorithmic systems, we will try to "redistribute the great divide," distancing ourselves from the debate on rationality.[10] Each in its own way, in different contexts and at different times, predictive practices claim to tell the truth about the future and, in so doing, contribute to forging worlds. In this respect, they cannot be assimilated to simple beliefs, forms of representation, or simple conceptions of the world, unless this term is considered in its materialistic sense. Indeed, by making the presence of the future tangible, they are fabrication methods or designs. In line with ontological approaches, it is crucial to grasp predictive practices by taking seriously their demiurgic powers of shaping the world. The term "demiurgic" is borrowed from the very elegant and insightful phrasing of Filip de Boeck and René Devisch, who call "the demiurgic capacity of divination" "a mode of worldmaking."[11]

Like divinatory techniques, algorithmic prediction systems must be considered as modes of knowledge aimed at ordering the world. Despite their differences, they share a common ambition: "[The] seemingly irresistible need to explain, to put things in order, to discover (or give them) meaning by observing (or establishing) in them relationships that make out of a disparate set of various sensations an organized fabric, unified in space, and, perhaps most importantly, in time."[12]

Beyond the simplistic opposition between the rational and the irrational, we will try to grasp the special type of coherence that is intrinsic to divinatory practices and to show how their singular rationality allows us to shed light on current algorithmic rationality. First, however, let us try to elucidate the specificity of predictive algorithms and to understand the new modes of knowledge production they entail.

The development of powerful algorithms now makes it possible to explore huge databases and perform "predictive analytics." In particular, new statistical analysis tools such as self-learning algorithms now make it possible to find unprompted correlations among massive amounts of diverse data and identify new forms of regularities, patterns, or modes of behavior. This mainly concerns unsupervised learning methods in which one of the objectives of the algorithm is to draw inferences from datasets without preexisting labels and to discover by itself previously unknown patterns.[13] As such, these systems constitute new ways of acquiring knowledge.[14] The evolution of algorithmic systems is closely linked to the phenomenon of big data, originating in the penetration of digital tools in all spheres of existence and the digitization of everyday life.[15] Algorithmic systems derive their strength and generality from the size of the databases to which they are applied. Thus, the more abundant the data, the more reliable and exploitable the correlations discovered by the machine will be.

Institutions, research, finance, and business all hope that predictive analytics will provide them with new tools in order to anticipate the future, facilitate decision-making, and reduce a range of risks. Predictive analytics encompasses a variety of statistical techniques from data mining to predictive modeling and machine learning that analyze current and historical facts to make predictions about future or otherwise unknown events. Predictive applications are already proliferating in our daily lives.[16] One of the most spectacular is undoubtedly the fight against crime and terrorism, with algorithms being increasingly used to anticipate the risks of offense or recidivism.[17] In business and finance, predictive models exploit patterns found in historical transactional data to identify risks and opportunities. These models can then be used for marketing purposes, for customer fraud detection, or as recommendation systems on e-commerce sites. In the banking and insurance sector, algorithmic systems have great potential in terms of detecting "weak signals," revealing shifts in the market or changes in customer behavior. In addition, they can be used for credit scoring in order to calculate a client's reliability in the loan process. Predictive analytics can also be successfully applied to the healthcare sector, where decision-making support systems are developed at both the individual (medical prognosis) and the public levels (pandemic prediction). Finally, it should be noted that predictive analytics is not limited to human affairs. It is also used to anticipate the occurrence and evolution of natural phenomena in the fields of meteorology or geology, for example.

CAUSATION OR CORRELATION: WHAT KNOWLEDGE ABOUT THE WORLD?

First, we will focus on the epistemological dimension of predictive practices, whether algorithmic or divinatory.[18] The aim will be to examine how these practices come to forge a certain knowledge about the future involving truth claims. There has been speculation that contemporary algorithmic systems contribute to the emergence of a new scientific paradigm that could revolutionize science and engineering. In a brief essay, provocatively titled "The End of Theory: The Data Deluge Makes the Scientific Method Obsolete," former *Wired* magazine editor Chris Anderson announced the emergence of a new paradigm in which "correlation supersedes causation, and science can advance even without coherent models, unified theories." He further added that now, "with enough data, the numbers speak for themselves."[19] The use of big data and the recourse to powerful data analytics tools would thus mark the end of theory and the emergence of a new form of empiricism fueled by the unprecedented correlations that algorithms successfully infer from gigantic datasets.

The explosion in the production of big data, along with the development of new epistemologies to make sense of those data, thus lead an argument that a paradigm shift from causation to correlation is under way. This paradigm shift would have far-reaching consequences for the production of knowledge. It would justify acting directly on the world and its multitude of complex phenomena without the need to understand their causes, since the "datafication" of everyday life at the heart of big data is "a way of accessing reality through bringing interactions and relationships to the surface and making them visible, readable, and thereby governable, rather than seeking to understand hidden laws of causality. Big Data is thereby generally understood to generate a different type of 'knowledge': more akin to the translation or interpretation of signs rather than that of understanding chains of causation."[20]

That such greatly exaggerated claims are given a platform is a symptom, together with sensationalist media coverage, of the marketing of a brand of "technological solutionism" via artificial intelligence applications by interested parties standing to profit from it and that has done great disservice to the field in the past.[21] Exalted claims about AI being one of the most important things that humanity is working on or that AI is the new electricity are characteristic of boom times in the field.

> The plot that best fits AI is "Fall and Rise," because, only 20 years ago, AI was a rather niche area with a somewhat questionable academic reputation—but since then it has risen to be the most vibrant and celebrated area in contemporary science. It would be more accurate, though, to say that the plot to the AI story is "Rise and Fall and Rise and Fall and Rise." AI has been the subject of continuous research for more than half a century, but during this time AI researchers have repeatedly claimed to have made breakthroughs that bring the dream of intelligent machines within reach, only to have their claims exposed as hopelessly over-optimistic in every case. Consequently, AI is notorious for boom-and-bust cycles—there have been at least three such cycles in the past four decades. At several points over the past 60 years, the bust has been so severe that it seemed like AI might never recover—and yet, in each case, it did.[22]

Saying that "the numbers speak for themselves" amounts to attributing near-magical powers to predictive algorithms, whom one needs only listen to, not unlike how diviners were not considered to be the ones who possessed the information but only skilled technicians who could read what was hidden in the signs or—in this case—repeat what the numbers are saying. It might well be an exaggeration to claim that the emergence of this new type of knowledge production challenges the foundations of science itself, whose fundamental pillars have been theory and experimentation for centuries. However, it is now widely accepted that data-driven sciences constitute a third pillar, and this situation raises many epistemological concerns.[23] When one looks closer at the discourses surrounding predictive analytics it is striking to observe how much these concerns strongly echo the heated debates related to divinatory practices during antiquity.

In his treatise on divination, Cicero staged a rhetorical battle between two brothers, Quintus and Marcus, about the forms of divination practiced under the Roman Republic. Here is what the former, a great supporter of divinatory practices, contends:

> Of these methods of divining it behooves us, I think, to examine the results rather than the causes. For there is a certain natural power, which now, through long-continued observation of signs and now, through some divine excitement and inspiration, makes prophetic announcement of the future. Therefore, let Carneades cease to press the question, which Panaetius also used to urge, whether Jove (Jupiter) had ordered the crow to croak on the left side and the raven on the right. Such signs as these have been observed for an unlimited time, and the results have been checked and recorded. Moreover, there is nothing which length of time cannot accomplish and attain when aided by memory to receive and records to preserve.[24]

This statement mimics almost word for word the argument that has become classic among the ideologists of big data and the supporters of new tools of predictive analytics: "We usually don't know about causation, and we often don't necessarily care. . . . [T]he objective is more to predict than it is to understand the world. . . . It just needs to work; prediction trumps explanation."[25] What is most striking about such claims is that they pit understanding and prediction against each other, whereas modern science views them as allies against ignorance: "We now face a choice about which kind of knowledge matters more—as well as the question of whether one stands in the way of scientific progress."[26] This choice is reflected in the rhetorical battle in Cicero's treatise.

More particularly, this passage from Cicero's treatise evokes two central themes or arguments that are of paramount importance in divinatory practices: *observatio* and *eventa*.[27] The theme of *observatio* relates to the empirical nature of divination. According to Quintus, the success of divination depends on experience and careful observation of phenomena over a long period. Over the centuries, people have succeeded in establishing links between events and certain types of signs. These observations have been listed, sorted, bequeathed to collective memory, and sometimes recorded in written documents. In this respect, Cicero refers to the origins of astrology in Mesopotamia and Egypt by showing that the science of celestial bodies relies on observations accumulated over centuries.[28] It is important here to relate the divinatory practices of which Quintus speaks to the type of cosmology that dominated the religious landscape at that time. Indeed, for Quintus, these practices are rooted in a Stoic conception of destiny, conceived of as an "eternal cause of things, the wherefore of things past, of things present, and of things to

come." Therefore, it follows that "it may be known by observation what effect will in most instances follow any cause, even if it is not known in all; for it would be too much to say that it is known in every case."[29]

The second theme mentioned by Quintus refers to the effectiveness of divination. He argues that in this matter it is necessary to take *eventa* into account, that is, results rather than causes. In other words, "it is the idea that it is not easy to explain the reason for each prediction, but that the facts themselves are indisputable."[30] Quintus, as a strong advocate of divination, rules out the etiological question and only focuses on facts and examples of successful predictions. To strengthen his argument, Quintus makes an interesting comparison with similar phenomena such as weather forecasts and the discovery of medicinal plants. These phenomena, whose reality and effectiveness are indisputable, proceed, according to him, from obscure causes shrouded in mystery. With regard to weather forecasts, Quintus refers to early signs of a change in the weather, such as signs of rain, expressed by animals such as crows and frogs: "Hardly ever do we see such signs deceive us and yet we do not see why it is so. Who could suppose that frogs had this foresight? And yet they do have by nature some faculty of premonition, clear enough of itself, but too dark for human comprehension. O do not ask why, since I know what happens."[31]

In the second part of Cicero's treatise, Marcus makes a fierce and often ironic criticism of his brother's arguments, highlighting, for instance, the differences among practices or the disagreement between haruspices and questioning the validity and even the existence of a continuous observation dating back to the earliest times, and so on.[32] In the limited framework of this article, it is impossible to review all these arguments. Nevertheless, it is important to point out that Marcus refutes Quintus's empirical argument by invoking a certain conception of philosophy according to which the philosopher is the one who not only sticks to the facts but also investigates the causes of phenomena.[33] Therefore, Marcus cannot be satisfied with the idea that the results of divination are convincing in themselves, regardless of any rational explanation:

> And although you could not give a reason for any kind of divination, still you carried on the war by marshalling an astonishing array of examples from fiction. Of such a course I wish to say emphatically that it is not becoming in a philosopher to introduce testimony which may be either true by accident, or false and fabricated through malice. You ought to have employed arguments and reason to show that all your propositions were true and you ought not to have resorted to so-called occurrences—certainly not to such occurrences as are unworthy of belief.[34]

Along those lines, Marcus identifies two levels of explanation missing in his brother's defense of divination: "First: the reason why such a phenomenon corresponds to this or that sign, favourable or not. But above all, the relationship between signifying phenomena and the signified events."[35] In practices such as haruspicy, astrology, and oneiromancy, the argument of *observatio* seems implausible. About the haruspicy, Marcus wonders: "In the first place, then, if you please, let us make 'an inspection' of entrails! Now can anybody be induced to believe that the things said to be predicted by means of entrails were learned by the soothsayers through 'long-continued observation'? How long, pray, did the observations last? How could these observations have continued for a long time? How did the soothsayers manage to agree among themselves what part of the entrails was unfavourable, and what part favourable; or what cleft in the liver indicated danger and

what promised some advantage?"[36] Deepening the question, Marcus wonders about the nature of entrails and the peculiar relationship between the viscera, the particular aspect of a liver, and the occurrence of an event such as the discovery of a treasure. According to which natural virtue can a liver be considered as the sign of a treasure? How can we understand this type of correspondence? What is the exact nature of these signs, and what is natural about them that can herald the future?[37]

> But what relationship have they with the laws of nature? Assuming that all the works of nature are firmly bound together in a harmonious whole (which, I observe, is the view of the natural philosophers and especially of those men who maintain that the universe is a unit), what connexion can there be between the universe and the finding of a treasure? . . . What natural tie, or what "symphony," so to speak, or association, or what "sympathy," as the Greeks term it, can there be between a cleft in a liver and a petty addition to my purse? Or what relationship between my miserable money-getting, on the one hand, and heaven, earth, and the laws of nature on the other?[38]

For Marcus, it is clear that it is impossible, namely, in the case of extispicy, to rationally account for the link between the sign and the foreseen event. Like his brother, he makes comparisons to reinforce his argument and refers to "stochastic arts" based on conjecture, such as medicine, navigation, strategy, and politics. For him, divination is radically different from practices such as weather forecasts and medical prognoses. Predictions in those different areas not only rely on true knowledge and experience but also are grounded in reason: "There are certain indications from the conditions of the pulse and breath and from many other symptoms in sickness by means of which physicians foretell the course of a disease. When pilots see cuttle-fish leaping and dolphins be taking themselves to a haven they believe that a storm is at hand. In such cases signs are given which are traceable to natural causes and explicable by reason, but that is far from true of the dreams spoken of a little while ago."[39] Ample evidence has been recently presented to the effect that divination practices are often best viewed as an epistemic technology, namely, tools or methods that people use to reveal hidden information in an effort to obtain factually accurate information about their world in order to inform their decisions and actions. As such, "many recurrent features of divination only make sense when such activities are viewed as attempts to generate true information. Divination practices, for example, often involve repetition to ensure that the revealed information isn't due to chance—like scientific experiments, divination protocols demand replication to build confidence."[40] Furthermore, overestimating the efficacy of divination has been found to owe to strong prior belief, underreporting of negative evidence, and misinferring belief from behavior, all of which can equally contribute to biased and inaccurate beliefs about the effectiveness of algorithmic divination too.

Marcus's investigation on the nature of the link between signs and events allows us to shed light on what is at stake in the new "data-driven science" and predictive analytics. Indeed, the intelligibility of the "correlationist" logic intrinsic to current algorithmic devices is at the heart of the current debates about this new mode of knowledge production. Here too, some levels of explanation seem to escape any investigation.

On the one hand, there is the thorny question of the nature of digital (meta)data. In what way can one assimilate them to signs? Should we consider them as "traces," "indices," or simple "signals"?[41] What is rather undisputed is that for predictive analytics purposes,

they are considered parameters, or input data, used to determine whether, for example, a loan applicant is creditworthy. Input data for such a purpose include various proxies, such as credit history, the purpose of the loan, the loan amount requested, employment status, income, marital status, gender, age, address, housing status, and credit score.[42] "Alternative data" such as web browsing and purchasing patterns, location, Facebook friends, typos in text messages, font types, time needed to fill out an online form, and even battery level can also be correlated with credit history to establish scores.[43]

It is also largely undisputed that most of these proxies lend themselves to unfair discrimination, directly or indirectly.[44] As the term "proxies" suggests, links between these signs and events such as loan default must exist. The objections nowadays are rather about the specific links that certain kinds of such signs or proxies have to events out of concern about the unfairness involved in perpetuating the bias and discrimination that are unfortunately part of the hidden truths about the world uncovered in the process of algorithmic divination. Therefore, the quality of the predictions "is only as good as the match between how the training data describes the world and the world as it is. If the training data reflects past inequality, any applicant who shares features with a historically underserved group will be flagged as less creditworthy than a comparable applicant who does not share the relevant feature."[45] This is what prompted the qualification of credit scoring systems as high risk in the recent EU Proposal for an AI Act.[46]

Given that machine learning algorithms depend on data to learn a specific task, the concerns that arise nowadays regard data availability and representativeness, compliance monitoring of datasets or algorithms against ethical and legal requirements, and the enforcement of these requirements without trading off on accuracy.[47] Certain safeguards against spurious correlations have therefore been developed, and while they are not foolproof, they do attest to efforts to acknowledge and address glaring and known weaknesses in the deployment of algorithms. For example, cost-sensitive classification envisages accuracy where the costs caused by different kinds of errors are not assumed to be equal and the objective is to minimize the expected costs based on their importance.[48] Furthermore, in order to explicitly incorporate ethical metrics into the algorithm, a multi-objective optimization approach can enable the algorithm to learn appropriate trade-offs between maximizing accuracy while satisfying ethical metrics.

More recent solutions to some of these challenges also include the use of synthetic data, which could help generate sufficient and relevant training data while reducing breaches of privacy, as these data would not contain personal information. This would, however, further undermine the links between signs and events in algorithmic divination, since the former's foothold in reality will have been largely forgone, while events would nevertheless be influenced by such synthetic predictions. Even so, the link between signs and events in algorithmic divination now encompasses more constraints and conditions of validity than it used to do, which in turn justifies stronger truth claims.

On the other hand, the question of the link between digital data and events is particularly acute at a time when predictive analytics rely on artificial intelligence systems, which demonstrate some abstraction, learning, and reasoning capabilities. In particular, machine-learning algorithms—which automatically discover significant correlations in large amounts of data in order to build predictive models—can create categories of their own that are not intelligible to humans.[49] In this case, one ends up with a model, empirically parameterized by the machine, whose logic is difficult to decipher and whose explicability is lacking. Furthermore, the methods used by these algorithms, chiefly, supervised

learning and reinforcement learning, are still far from efficient. Supervised learning requires many examples, as well as a lot of human annotation, and reinforcement learning requires many trials and errors, as well as some way to simulate the action it is geared toward. The missing piece, background knowledge, seems to have so far largely escaped us. An attempt at completing the puzzle is self-supervised learning, a big part of which is, in a rather nice historical arc, observation. Watching the world go by, like diviners used to do, although now free from some of the time constraints due to the modern capacity and propensity to record everything, is still subject to the constraints of truth telling.

Whether praised or condemned, this new empirical epistemology and its purely inductive methods have penetrated the field of science to the point that some authors suggest a real paradigm shift.[50] In this respect, Cicero's treatise on divination is even more valuable in that it explicitly raises the question of the transition, or the entanglement between two types of rationality, beyond the simplistic opposition between rational and irrational thinking. Throughout the treatise, Cicero's position toward divination is more nuanced than it seems, because he tries to understand the type of coherence inherent in divinatory practices and to understand how their rationality, when unveiled, compares to the emerging scientific rationality. As some commentators point out, Cicero's skepticism must therefore be put into perspective and instead considered as a desire to combat superstition while respecting religion.[51] Cicero, having himself the status of an augur under the republic, was not averse to all forms of divination. As a philosopher, his ambition was "to understand the correspondences between phenomena in divination in order to allow their rational use, without recourse to 'superstition.'"[52]

While current criticisms of algorithmic systems and the ideology of big data may seem legitimate, it seems that they leave a field of investigation largely unexploited by denouncing only the most radical uses of data analytics and their fantasies of objectivity, exhaustiveness, and predictability.[53] From the point of view of ethnographic investigation, it is crucial, we contend, to grasp the new and diverse reconfigurations of scientific epistemology. The aim is therefore not to consider predictive analytics as inadmissible or dangerous from the outset but to deploy a nuanced approach that would question their possible hybridization with other traditional epistemologies and methods, examining their feedback effects on hypothesis formulation and theory building.[54]

UNVEILING OR CONSTRUCTION: WHAT KIND OF RELATIONSHIP TO THE WORLD?

Whether divinatory or algorithmic, prediction practices, by actualizing the presence of the future, contribute to shaping the world: "By claiming to possess knowledge about the future, these logics necessarily imply specific modes of defining what matters, what does not and what can be legitimately regarded as constituting part of the world."[55] In this sense, prediction is indeed a "project of world making."[56] For this reason, prediction practices nurture ontological conceptions involving a certain type of relationship between humans and other entities that inhabit the world.

In Cicero's treatise, Quintus's arguments in favor of divination are grounded in a conception of the world according to which there is a special kind of solidarity between the various parts of the universe and thus a link of natural sympathy connecting the divinatory sign to the future event, allowing prediction. In particular, for Quintus, divination draws its substance from the intrinsic links between gods, fate, and nature in the Stoic

conception of the universe. Divination is justified (in its various forms) first by the Stoic theory of gods (they exist and exercise providence), then by the Stoic theory of destiny (according to which nothing happens without causes and signs that reveal future events), and finally according to the Stoic theory of nature (the divine principle of unity and the link connecting apparently unrelated events between them).[57]

Within this conception of the universe, only the gods hold a global knowledge of the chain of causes. Humans, for their part, do not see the causes—not even the diviner—and can only perceive signs:

> But since such knowledge is possible only to a god, it is left to man to presage the future by means of certain signs which indicate what will follow them. Things which are to be do not suddenly spring into existence, but the evolution of time is like the unwinding of a cable: it creates nothing new and only unfolds each event in its order. This connexion between cause and effect is obvious to two classes of diviners: those who are endowed with natural divination and those who know the course of events by the observation of signs. They may not discern the causes themselves, yet they do discern the signs and tokens of those causes. The careful study and recollection of those signs, aided by the records of former times, has evolved that sort of divination, known as artificial, which is the divination by means of entrails, lightnings, portents, and celestial phenomena.[58]

This excerpt reveals a fundamental feature of divination: it gives access to a kind of hidden truth, to an invisible world that the human mind cannot reach by its own forces, as Auguste Bouché-Leclercq writes. For this author, divination is "a knowledge of a special nature, more or less direct, more or less complete, but always obtained by means of supernatural revelation, with or without the aid of reason. The domain of divination is all that the human mind cannot know by its own forces: first of all the future, insofar as it escapes rational prediction, then the past and the present, in that which is inaccessible to ordinary investigation."[59] So Quintus, while praising the merits of divination, concedes to his brother that he cannot explain the cause and affirms: "I fail—you tell me—to discover their cause. That, perhaps, is one of Nature's hidden secrets. God has not willed me to know the cause, but only that I should use the means which he has given. Therefore, I will use them."[60] In different cultures, characters such as the diviner and the shaman are entrusted with the mission of penetrating this darkness, interpreting its signs, and, in so doing, unveiling the links between the visible and the invisible. This is not unlike the role of today's developers of predictive algorithms, who in exchange for their "arcane knowledge and access to the software they produce command hefty salaries" and comparable levels of authority in their interpretations of largely opaque predictions.[61]

The problem of the complex interplay between the visible and the invisible—an interplay that structurally characterizes the logic of divinatory practices—is now at the heart of the contemporary belief in the predictive power of algorithms. The function of algorithms is, then, to drill into databases ("data-mining") in order to bring out from this second digital nature significant information ("insights") previously unknown to us: "Any culture which admits the use of oracles and divination is committed to a distinction between appearance and reality. The oracle offers a way of reaching behind appearances to another source of knowledge. . . . For this is a perennial problem in philosophy. It is as alive today as it was for Parmenides and Plato."[62] This semantics reflects very explicitly the ancestral idea of "secrets of nature." As Pierre Hadot has shown, the idea of hidden

secrets of nature comes from Greco-Latin philosophy and has penetrated the field of science throughout history with different interpretations.[63]

Common to divinatory and scientific practices, this idea of nature's secrets is not, however, understood in the same way. Indeed, if in both cases the objective is to discover a hidden reality, the one that divinatory practices purport to discover is seemingly not the same as the reality that scientific research refers to. On the one hand, in the context of divinatory practices, the reality that humans try to access is transcendental, unique, absolute, infinite, and eternal, whereas the one experienced by humans is nothing but an illusion, an appearance, always partial and relative.

On the other hand, scientific practices, far from designating an unattainable and unspeakable absolute, "are the result . . . of an empirico-mathematical confrontation where nothing is supposed to escape the quantitative discourse, that is, determined by the conditions of measurement and measurability."[64] In scientific practices, the relationship between understanding and prediction "corresponds to a link between ontology (insights into the true nature of the world) and epistemology (the process of gaining knowledge about the world). Knowledge based on experiments can break through the barriers of our existing understanding and yield an appreciation for new and fundamental features of reality; in turn, those fundamental laws allow scientists to generate fresh predictions to test out in the world."[65]

Today, it would be necessary to grasp with nuance the implications of this quantitative discourse and, in particular, to measure its impact on our way of conceiving the relationships between reality and appearance. For John Dewey, those relationships are of crucial importance: "If science be perfect grasp, or envisagement of being, and if science terminate with a mathematico-mechanical world, then, in the second place, we have upon our hands the problem of reality and appearance. . . . The difference between the appearing and the unappearing is of immense practical and theoretical import, imposing upon us need for inference, which would not exist if things appeared to us in their full connections, instead of with sharply demarcated outlines due to limits of perceptibility."[66]

Grasping the interplay between reality and appearance requires us today to understand the shift from the "mechanization of the world" to its "digitization." For Hadot, "the phenomenon that characterizes the evolution of our civilization and that has been called the 'mechanization of the world' consists mainly in the application of mathematics to the knowledge of the world phenomena."[67] The massive collection of digital data and the development of algorithmic systems capable of analyzing them nurture the idea that it would be possible to have almost immediate access to the world itself and its secrets without the need to practice inferences or to interpret the world through language and theory. Thus, the digitization of the world made possible by the technologies we use in our daily lives is, for some authors, a kind of exhaustive and objective duplication of reality.[68] Much more than the microscopes or telescopes of the moderns, algorithmic systems would then allow more fully embracing reality by making visible the multiplicity of connections between things and humans.[69]

The opacity characterizing the algorithms and the machines that run them seems to be in complete contradiction with the quest for truth that characterizes the scientific tradition.[70] A case in point is natural language processing, which, once it abandoned trying to understand speech via mathematical models based on the syntactic and semantic structure of human speech and embraced prediction with the arrival of deep neural networks, went on to become very effective at it, albeit resigned in the face of algorithmic opacity.[71]

The inherent opacity of contemporary algorithmic systems is now strongly criticized by many authors and for various reasons that are as diverse as the forms opacity can take.[72]

The first form of opacity relates to the status of computer "black boxes," whose computational complexity and logic can only be understood by specialists.[73] In this respect, the knowledge of the computer scientist is similar to that of the diviner. Indeed, to take the auspices or decipher the viscera, it is necessary to have learned, through training or initiation, the meaning of the signs and, in addition, to have some experience of the discipline.[74] Furthermore, diviners are ranked according to perceived skill, ability, or success, and they are commonly referred to as skilled technicians across history, much like developers of digital predictive technologies are nowadays.[75] Opacity characterizes here above all the perception that the layman has of algorithms.

The second form of opacity questioned in the literature relates to predictive algorithmic systems based on artificial intelligence. Far beyond the problem of digital literacy, the functioning of self-learning algorithms used for predictive analytics can be obscure even for specialists: "The opacity of machine learning algorithms is challenging at a more fundamental level. When a computer learns and consequently builds its own representation of a classification decision, it does so without regard for human comprehension. Machine optimizations based on training data do not naturally accord with human semantic explanations."[76]

As already mentioned, the intelligibility of the correlations and categorizations made by the algorithm is sometimes lacking, making it difficult to trace the different steps leading to a decision. Because it has no clear motives or explanation, it requires a particularly delicate interpretation comparable to what happens in divinatory practices. Indeed, when it comes to divination, "deciphering a sign, a dream, an oracle, remains a difficult thing. Especially in the case of technical divination, a dubious sign may be mistaken for certain or escape the observer or be replaced by another of opposite value."[77] This second level of technical opacity is also problematic because it has the effect of masking possible errors and biases resulting from the use of certain algorithmic systems. In the case of predictive models, this can lead to serious problems of discrimination or the detection of "false positives," as in the often-dramatic cases of recidivism risk assessment and the identification of persons with no real terrorist intent.[78]

Finally, a third form of opacity associated with contemporary algorithmic systems has a more institutional dimension. This kind of opacity is part of a culture of secrecy that is intentionally deployed by some organizations not only through legal provisions on intellectual property that impede access to the code but more generally through a set of insidious and cunning economic and political practices.[79] These practices—which sometimes aim to mislead users, to steal data from them, to monitor their behavior for malicious purposes—constitute what Frank Pasquale calls in his prominent book a "black box society."[80]

These different forms of opacity and the process of "invisibilization" in which they are enmeshed strangely recall the implications of the divinatory methods used by Wolof sorcerers in West Africa. As Tobie Nathan describes it, "Divination is not intended to make hidden things visible. Its function is to establish the very place of the invisible."[81] When one resorts to divination through one technique or another, one always presupposes the existence of a universe that is not only populated by human beings. Nonhumans exist, their place is determined, as are the rules governing our interactions with them. What is the "place of the invisible" that contemporary prediction practices help to establish? What type of universe do they presuppose, and who are its inhabitants? Through contemporary

prediction devices, the invisible, whose place needs to be established, is not a supernature populated by entities and spirits with whom one must communicate. Rather, it is a digital infrastructure, a kind of subtle emanation of life, an algorithmic duplication of the world populated by billions of data points. When convened, these data, some say, "speak for themselves," revealing hidden things that enable us to act on the world.

This construction of a particular relationship between the visible and the invisible allows us to insist on the topological dimension of divinatory or predictive practices, a dimension that is often minimized or even overlooked in the literature. Visibility is conventionally defined as "the mere quality for an object to be seen more or less clearly in a given space."[82] Indeed, scholars tend to favor temporal approaches because of the very nature of these practices. However, these approaches are not only concerned with time but also forms of occupation of space and bodies. In this respect, we must postulate a link between (in)visibility and power, our future being fundamentally linked to acting on the world and controlling what happens to us and our projects.[83] In divinatory practices, the exercise of power over the world is based on the assumption that the prediction of the future is possible and that the future can be seen or even read through different signs. Although the signs are different in the case of algorithmic divination, the underlying logic of apprehending the future through prediction is similar.

CONCLUSION

As I have tried to show, divinatory practices and contemporary predictive systems have a double dimension, both epistemological and ontological. Divination in its underlying epistemological dimension is a form of inquiry aimed at producing knowledge about the world and laying the foundations for such knowledge. As we have seen, divination relies on the development of a "grammar of unusual links" between signs and events.[84] In particular, the epistemology of divination is grounded in the principle of a noncausal succession between the sign and the foreseen event. To predict is thus to establish correlations between events by avoiding a methodical investigation of their causes.

The attention paid to the epistemological dimension of divination invites us to consider it as "a mode of discovery that makes a truth-claim with regard to how it represents the world."[85] Like scientific activities, divinatory practices therefore claim to produce true knowledge about the world. At this stage, the lessons of symmetry taught by Bruno Latour or Eduardo Viveiros de Castro are salient.[86] They help to avoid a double pitfall: either the disqualification of indigenous beliefs or conceptions on the pretext that they would be false, illusory, even irrational; or the promotion of these conceptions on the basis of their greater or lesser continuity with science, fruits of the same desire to know that unites all human beings.[87]

Taking the epistemology of predictive practices (whether divinatory or algorithmic) and their truth claims seriously requires looking at the felicity conditions of these "systems of knowledge in action" and deciphering the mechanisms by which they might count as truth.[88] In this perspective, it is crucial to investigate the specific conditions that allow divinatory or algorithmic verdicts to impose themselves as unquestionable knowledge. For Martin Holbraad, the question of "indubitability," very often overlooked by the discipline, must be at the heart of ethnographic investigation if it is to reflect how predictive statements are capable of producing the "truth."[89]

As the examples in Cicero's treatise illustrate, the systems of observation and interpretation of signs specific to the Greek or Roman divinatory art are so complex that it

is practically impossible to question their validity.[90] The organization of such complexity makes it possible to preserve the divinity's honor. In any case, if the divinatory verdict is wrong, it is only because of the interpreter's shortcomings. At a time when algorithms are presented to us as tools that compensate for human biases and weaknesses, it is urgent to question the mechanics of a normativity that unfolds by soliciting from a third party, no longer divine but algorithmic, if not an undoubted and infallible last word, then at least one less prone to error than its human counterparts.

Thus, predictive practices provide legitimate grounds for decision-making alongside the strictly predictive function. In this respect, digital signals have replaced divine signs, and data now have "the same function as the omens of the past: to immunize decision-making against failure."[91] In the case of creditworthiness assessments for loans, for example, findings indicate that while AI systems discriminate, they seem to do so 40 percent less than human loan officers, which largely justifies their appeal.[92] It also fuels their perception as more objective, making it more difficult to question their lacking explainability and uncover their own, albeit less frequent, failings. The potential scale of their negative effects, however, differs from the largely local, limited ones that classical divinatory practices exhibit and that largely affect individuals, families, and small communities. Predictive analytics instead are employed at scale by corporations and states, which means that they can more readily perpetuate systemic inequalities.[93]

Given the stakes, it is no wonder that explainable AI has developed into a subdiscipline. Dispelling myths about the true powers of AI systems while at the same time tackling how knowledge and prediction can be culturally interpreted and misunderstood might benefit from insights into how contemporary science deals with and conveys uncertainty in the realm of phenomena as complex as climate change and the evolution of biodiversity.[94] Meaningful climate science, by adopting a storyline approach to climate variability and changes, in which a storyline is understood as a physically self-consistent unfolding of past events or of plausible future events or pathways, has, for instance, managed to qualitatively package the quantitative aspects of climate science into a meaningful interpretation of data.[95] Interpretation is what divination was primarily concerned with as well. There was always a certain ambiguity involved in divinatory practices, which required the expertise of diviners to make sense of the signs. But while diviners were concerned with interpretability, the standard of knowledge production has with the arrival of algorithmic divination been raised to explainability.

Whatever the form, divination yields specific views of the future in answer to specific questions that foreclose what could be the case. To grasp the truth claims of divinatory practices, it is necessary to have regard to their ontological dimension. These practices claim to detain knowledge about the future because they necessarily imply specific ways of defining "what may count as a world, along with its various constituents."[96] As we have seen, predictive practices have been described as "demiurgic" in that they shape the world by bringing about the presence of the future in the here and now. Here, the term "world" could just as easily be replaced by "nature" or "cosmos."[97] Cicero's reflections on Stoic divination rightly illustrate this operation of worldmaking. In this case, the future of humankind is made present through the elaboration of a cosmology characterized by a continuous and cyclical space-time, itself animated by a principle of sympathy according to which the future can be read in the flight of birds. This cosmology implies a certain idea of time and space, nature and life (pneuma), as well as fate and the different strategies of escaping it.

In an effort to achieve symmetry, we should wonder today what is the ontological status of the future on which the algorithmic predictive systems fed by massive quantities of digital signals and traces are based. How do algorithms reflect "what has not and may never happen"?[98] And how does the spectral presence of the future participate in the construction of a peculiar ontology that serves as a foundation for the cosmology of our contemporaries? In this cosmology, made up of speaking numbers, smart objects, cloud computing, and digital oracles, the future seems to be built from a digitized present that reduces life to the electronic traces and signals it generates.

This digital duplication of life reveals, arguably, a completely original conception of life: "*life as a pure contingency*."[99] The digitization of reality and the multiplication of technical devices feeding on data in our daily lives now allow engineers to speak of "augmented reality." Unlike Stoic determinism, life is now conceived as an emerging, unpredictable, dynamic, and nonlinear event, a vector of both dangers and opportunities. In a complex world characterized by an inextricable entanglement of multiple flows and events, the present is constantly assaulted by a proliferation of possible futures that incubate within life and can create surprise. Algorithmic predictive systems should then serve to face the contingent nature of life and make the future "actionable" by providing knowledge about the most improbable scenarios. By shaping the future in this way, algorithmic systems make it possible to deploy preemptive strategies—characteristic of what Frédéric Neyrat calls "societies of clairvoyance"—designed to neutralize the emergence of the improbable by crushing the present and making any event or action impossible.[100] In her work on predictive systems used in finance, Elena Esposito wonders whether we should not speak of "de-futurisation" techniques that reduce the openness of the future without giving the impression that they work in this way, since they claim to prepare for any eventuality by envisaging several possible futures.[101] This can be illustrated by the use of algorithmic systems for predictive policing and fighting against terrorism.

It is not a very daunting task to imagine the normative consequences of this new kind of naturalistic cosmology, to which we have recently added a digital layer. One of the structural problems of naturalism, Philippe Descola warned us, is that it does not really know how to place Culture, that is, humans, in the universality of Nature.[102] With contemporary predictive algorithms, one must once again address this question. By reducing people to their "digital nature," there is an increasing risk that individuals will be subjected to a profile without being given the opportunity to tell who they truly are, to put their life trajectories into words, to account for their actions through actual language beyond the "digital replicants" that are supposed to represent them. Like the ancestral practices of divination that Cicero criticized, these systems fundamentally question the very idea of human freedom.

In such a context, can one still talk about pre-*diction*? The act of *dicere* ("to say" in Latin) seems to be absent from the operation of the digital (de)cyphering of life. Moreover, are there still things "to say" when "the numbers speak for themselves"? The verb "to say," as Tim Ingold reminds us, has two related meanings: "On the one hand, a person who can 'say' is able to put the world into stories. On the other hand, that same person is able to recognize certain subtle cues in his or her environment and react to them with discernment and precision."[103] In an age of big data and intelligent algorithmic devices, it is this first meaning that we must preserve, because it guarantees everyone the possibility of a future to be invented.

NOTES

Acknowledgments: I would like to thank the anonymous reviewers for their careful reading of this article and their insightful comments and suggestions. This article also benefited greatly from critical reading and many important improvements proposed by my brilliant colleague Diana Mocanu.
Author declaration: The author declares no conflict of interest.

1. Frank Romeike and Andreas Eicher, "Predictive Analytics: Looking into the Future," in *FIRM Yearbook 2016* (Frankfurt am Main, 2016), 169; see also Paul McFedries, "Data Divination," *IEEE Spectrum*, January 19, 2017, 25, https://spectrum.ieee.org/data-divination; Pam Baker and Bob Gourley, *Data Divination: Big Data Strategies* (Boston: Cengage Learning PTR, 2014).

2. Dan Sperber, "Apparently Irrational Beliefs," in *Rationality and Relativism*, ed. M. Hollis and S. Lukes (Oxford: Blackwell Publishing, 1982), 149–80, http://www.dan.sperber.fr/wp-content/uploads/1982_apparently-irrational-beliefs.pdf.

3. Georges Minois, *Histoire de l'avenir: Des prophètes à la prospective* (Paris: Fayard, 1996).

4. François Guillaumont, *Le De diuinatione de Cicéron et les théories antiques de la divination* (Brussels: Peeters Publishers, 2006), 95.

5. Cicero, *"On Old Age," "On Friendship," "On Divination,"* trans. W. A. Falconer (Cambridge, MA: Harvard University Press, 1923), 1:127, 2:26–27.

6. Auguste Bouché-Leclercq, *Histoire de la divination dans l'antiquité* (Paris: E. Leroux, 1879); Raymond Bloch, *La divination: Essai sur l'avenir et son imaginaire* (Paris: Fayard, 1991).

7. François Guillaumont, *Le De diuinatione de Cicéron et les théories antiques de la divination* (Brussels: Peeters Publishers, 2006), 94.

8. Cicéron, *De la divination*, ed. José Kany-Turpin (Paris: Flammarion, 2004), 7–86.

9. Stanley J. Tambiah, *Magic, Science and Religion and the Scope of Rationality* (Cambridge: Cambridge University Press, 1990).

10. Bruno Latour, "Comment redistribuer le Grand Partage?," *Revue de Synthèse* 110 (April/June 1983): 221.

11. Filip de Boeck and René Devisch, "Ndembu, Luunda and Yaka Divination Compared: From Representation and Social Engineering to Embodiment and Worldmaking," *Journal of Religion in Africa* 24, no. 2 (1994): 100, https://doi.org/10.2307/1581328.

12. Henri Atlan, *À tort et à raison: Intercritique de la science et du mythe* (Paris: Éditions du Seuil, 1986), 187.

13. Gregory Wheeler, "Machine Epistemology and Big Data," preprint, November 15, 2016, http://philsci-archive.pitt.edu/12804/.

14. Lev Manovich, *Software Takes Command* (New York: Bloomsbury Academic, 2013), 338.

15. The big data phenomenon is often described using the logic of the three Vs: (1) volume, referring to the quantity or the magnitude of the data; (2) variety, referring to the structural heterogeneity of a data set; (3) velocity, referring to the rate at which data are generated and the speed at which they should be analyzed. It should be noted that the huge mass of data exploitable by algorithmic systems is derived from all the data we leave behind while using digital technologies such as computers and mobile phones. Along with the data that offer explicit content or subjective information (e.g., a post on Facebook), we need to consider "metadata." This term refers to traces that, without being part of the content of the communication, serve,

for example, to its transmission: origin, recipient, date, geographical position, and so on. In this sense, the metadata are literally data about other data. See Valeria Cortez, "Preventing Discriminatory Outcomes in Credit Models," *Medium*, June 19, 2019, https://towardsdatascience.com/preventing-discriminatory-outcomes-in-credit-models-39e1c6540353; Dominique Cardon, *A quoi rêvent les algorithmes: Nos vies à l'heure des big data* (Paris: Seuil, 2015), 62–63.

16. Adrian Mackenzie, "The Production of Prediction: What Does Machine Learning Want?," *European Journal of Cultural Studies* 18, no. 4–5 (August 2015): 429–45, https://doi.org/10.1177/1367549415577384.

17. Jude McCulloch and Dean Wilson, *Pre-crime: Pre-emption, Precaution and the Future* (London: Routledge, 2015).

18. Knut Christian Myhre, "Divination and Experience: Explorations of a Chagga Epistemology," *Journal of the Royal Anthropological Institute* 12, no. 2 (2006): 313–30, https://doi.org/10.1111/j.1467-9655.2006.00293.x; Knut Graw, "Beyond Expertise: Reflections on Specialist Agency and the Autonomy of the Divinatory Ritual Process," *Africa: Journal of the International African Institute* 79, no. 1 (2009): 92–109, https://doi.org/10.3366/E0001972008000624; Martin Holbraad, *Truth in Motion: The Recursive Anthropology of Cuban Divination* (Chicago: University of Chicago Press, 2012).

19. Chris Anderson, "The End of Theory: The Data Deluge Makes the Scientific Method Obsolete," *Wired*, June 23, 2008, https://www.wired.com/2008/06/pb-theory/.

20. David Chandler, "A World without Causation: Big Data and the Coming of Age of Posthumanism," *Millennium* 43, no. 3 (June 2015): 836, https://doi.org/10.1177/0305829815576817.

21. Evgeny Morozov, *To Save Everything, Click Here*, reprint ed. (New York: PublicAffairs, 2014).

22. Michael Wooldridge, *The Road to Conscious Machines: The Story of AI* (London: Pelican, 2021), 21.

23. "US NSF—MPS—Computational and Data-Enabled Science and Engineering (CDS&E)," accessed December 19, 2022, https://www.nsf.gov/mps/cds-e/.

24. Cicero, *"On Old Age,"* 1:12.

25. Eric Siegel and Thomas H. Davenport, *Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die* (Hoboken, NJ: Wiley, 2013), 90.

26. David C. Krakauer, "Will Brains or Algorithms Rule the Kingdom of Science?," *Aeon*, April 20, 2020, https://aeon.co/essays/will-brains-or-algorithms-rule-the-kingdom-of-science.

27. Guillaumont, *Le De diuinatione*, 112.

28. Cicero, *"On Old Age,"* 1:2.

29. Cicero, 1:126.

30. Guillaumont, *Le De diuinatione*, 112.

31. Cicero, *"On Old Age,"* 1:15.

32. Cicéron, *De la divination*, 44.

33. Guillaumont, *Le De diuinatione*, 156.

34. Cicero, *"On Old Age,"* 2:27.

35. Cicéron, *De la divination*, 53.

36. Cicero, *"On Old Age,"* 2:28.

37. Cicero, 2:29.

38. Cicero, 2:33–34.

39. Cicero, 2:145.

40. Ze Hong and Joseph Henrich, "The Cultural Evolution of Epistemic Practices," *Human Nature* 32, no. 3 (September 2021): 622–51, https://doi.org/10.1007/s12110-021-09408-6.

41. Carlo Ginzburg, "Signes, traces, pistes: Racines d'un paradigme de l'indice," *Le Débat* 6, no. 6 (1980): 3–44, https://doi.org/10.3917/deba.006.0003; Antoinette Rouvroy and Bernard Stiegler, "Le régime de vérité numérique," *Socio: La Nouvelle Revue des Sciences Sociales*, April 25, 2015, 113–40, https://doi.org/10.4000/socio.1251.
42. Karima Makhlouf, Sami Zhioua, and Catuscia Palamidessi, "Machine Learning Fairness Notions: Bridging the Gap with Real-World Applications," *Information Processing & Management* 58, no. 5 (September 2021): 102642, https://doi.org/10.1016/j.ipm.2021.102642.
43. Katja Langenbucher, "AI Credit Scoring and Evaluation of Creditworthiness: A Test Case for the EU Proposal for an AI Act," in *Proceedings of the European Central Bank's Conference on "Continuity and Change: How the Challenges of Today Prepare the Ground for Tomorrow"* (Luxembourg: Publications Office of the European Union, 2022), 363.
44. Thibault Magnini, Diana Mocanu, Divya Singh, and Carolien Van de Bruaene, "The Road to Assess People's Creditworthiness with AI Systems: Paved with Good Intentions?," *The Law, Ethics & Policy of AI Blog*, October 25, 2022, https://www.law.kuleuven.be/ai-summer-school/ai-assessment-creditworthiness.
45. Langenbucher, "AI Credit Scoring," 363.
46. Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts, COM/2021/206 final, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52021PC0206.
47. Cortez, "Preventing Discriminatory Outcomes."
48. Charles X. Ling and Victor S. Sheng, "Cost-Sensitive Learning and the Class Imbalance Problem," in *Encyclopedia of Machine Learning*, ed. C. Sammut (Berlin: Springer, 2008), 8.
49. Research Ethics Board of the Digital Sciences and Technologies Alliance (Allistene), "CERNA Report, Research Ethics in Machine Learning," February 2018, http://cerna-ethics-allistene.org/digitalAssets/54/54730_cerna_2017_machine_learning.pdf.
50. Rob Kitchin, "Big Data, New Epistemologies and Paradigm Shifts," *Big Data & Society* 1, no. 1 (April 2014): 2053951714528481, https://doi.org/10.1177/2053951714528481; Tony Hey et al., *The Fourth Paradigm: Data-Intensive Scientific Discovery* (Microsoft Research, 2009), https://www.microsoft.com/en-us/research/publication/fourth-paradigm-data-intensive-scientific-discovery/.
51. Guillaumont, *Le De diuinatione*, 325.
52. Cicéron, *De la divination*, 78.
53. Rouvroy and Stiegler, "Le régime."
54. Lev Manovich, "460Trending: The Promises and the Challenges of Big Social Data," in *Debates in the Digital Humanities*, ed. Matthew K. Gold (Minneapolis: University of Minnesota Press, 2012), https://doi.org/10.5749/minnesota/9780816677948.003.0047; Kitchin, "Big Data"; S. Leonelli, "What Difference Does Quantity Make? On the Epistemology of Big Data in Biology," *Big Data & Society* 1, no. 1 (April 2014): 2053951714534395, https://doi.org/10.1177/2053951714534395.
55. Christophe Lazaro and Marco Rizzi, "Predictive Analytics and Governance: A New Sociotechnical Imaginary for Uncertain Futures," *International Journal of Law in Context*, October 3, 2022, 1–21, https://doi.org/10.1017/S1744552322000477.
56. Jenny Andersson, *The Future of the World: Futurology, Futurists, and the Struggle for the Post Cold War Imagination* (Oxford: Oxford University Press, 2018), 23.
57. Guillaumont, *Le De diuinatione*, 199.
58. Cicero, *"On Old Age,"* 1:127.

59. Bouché-Leclercq, *Histoire de la divination*, 7.
60. Cicero, *"On Old Age,"* 1:35.
61. Matthew Gwynfryn Thomas, "The Age of Digital Divination," *Sapiens*, December 7, 2021, https://www.sapiens.org/culture/digital-divination/.
62. Mary Douglas, "If the Dogon . . . ," *Cahiers d'Études Africaines*, 1967, 663.
63. Pierre Hadot, *Le voile d'Isis: Essai sur l'histoire de l'idée de nature* (Paris: Folio Essais, 2008).
64. Atlan, *À tort et à raison*, 120.
65. Thomas, "The Age of Digital Divination."
66. John Dewey, *Experience and Nature* (Chicago: Open Court, 1925), 137–38.
67. Hadot, *Le voile d'Isis*, 149.
68. Chandler, "A World without Causation," 836.
69. Hadot, *Le voile d'Isis*, 177; Philippe Descola, *Par-delà nature et culture* (Paris: Gallimard, 2005), 97.
70. Joffrey Becker, "Le corps humain et ses doubles," *Gradhiva: Revue d'Anthropologie et d'Histoire des Arts*, May 16, 2012, 114, https://doi.org/10.4000/gradhiva.2335.
71. Krakauer, "Will Brains or Algorithms?"
72. Jenna Burrell, "How the Machine 'Thinks': Understanding Opacity in Machine Learning Algorithms," *Big Data & Society* 3, no. 1 (June 2016): 2053951715622512, https://doi.org/10.1177/2053951715622512.
73. Jannis Kallinikos, "Reopening the Black Box of Technology Artifacts and Human Agency," in *ICIS 2002 Proceedings* (2002): 26, https://aisel.aisnet.org/icis2002/26.
74. Guillaumont, *Le De diuinatione*, 90.
75. Hong and Henrich, "The Cultural Evolution."
76. Burrell, "How the Machine 'Thinks.'"
77. Cicéron, *De la divination*, 55.
78. Tal Z. Zarsky, "Transparent Predictions," *University of Illinois Law Review* 2013 (2013): 1503; Julia Angwin, Jeff Larson, Surya Mattu, and Lauren Kirchner, "Machine Bias," *ProPublica*, May 23, 2016, https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing; Timme Bisgaard Munk, "100,000 False Positives for Every Real Terrorist: Why Anti-terror Algorithms Don't Work," *First Monday* 22, no. 9 (September 2017), https://doi.org/10.5210/fm.v22i9.7126.
79. Lev Manovich, "The Practice of Everyday (Media) Life: From Mass Consumption to Mass Cultural Production?," *Critical Inquiry* 35, no. 2 (January 2009): 319–31, https://doi.org/10.1086/596645.
80. Frank Pasquale, *The Black Box Society: The Secret Algorithms That Control Money and Information* (Cambridge, MA: Harvard University Press, 2016).
81. Tobie Nathan, "Manifeste pour une psychopathologie scientifique," in *Médecins et sorciers: Manifeste pour une psychopathologie scientifique, le médecin et le charlatan*, ed. Tobie Nathan and Isabelle Stengers (Le Plessis-Robinson: Empêcheurs de penser en rond, 1999), 68.
82. Jean-Noël Tardy, "Visibilité, invisibilité. Voir, faire voir, dissimuler," *Hypothèses* 10, no. 1 (2007): 17, https://doi.org/10.3917/hyp.061.0015.
83. Tardy, 18; Luca Pattaroni, "Petit glossaire du futur pour une lecture démocratique de notre avenir," *EspacesTemps.net: Revue Électronique des Sciences Humaines et Sociales*, June 23, 2015, https://www.espacestemps.net/articles/petit-glossaire-du-futur-pour-une-lecture-democratique-de-notre-avenir/.

84. Christian St-Germain, "La question des augures à Rome: L'éthique du devenir incertain," *Théologiques* 8, no. 1 (2000): 95, https://doi.org/10.7202/005028ar.
85. Myhre, "Divination and Experience," 314.
86. Bruno Latour, *Sur le culte moderne des dieux faitiches: Suivi de Iconoclash* (Paris: La Découverte, 2009); Eduardo Viveiros de Castro, "The Relative Native," *HAU: Journal of Ethnographic Theory* 3, no. 3 (December 2013): 473–502, https://doi.org/10.14318/hau3.3.032.
87. Viveiros de Castro, "The Relative Native," 487.
88. Philip M. Peek, ed., *African Divination Systems: Ways of Knowing* (Bloomington: Indiana University Press, 1991), cited by Graw, "Beyond Expertise," 93.
89. Holbraad, *Truth in Motion*, 59.
90. Cicéron, *De la divination*, 271.
91. Lazaro and Rizzi, "Predictive Analytics."
92. Robert Bartlett et al., "Consumer-Lending Discrimination in the FinTech Era," n.d., 44.
93. Thomas, "The Age of Digital Divination."
94. Erik J. Larson, *The Myth of Artificial Intelligence: Why Computers Can't Think the Way We Do* (Cambridge, MA: Belknap Press, 2021).
95. Theodore G. Shepherd and Elisabeth A. Lloyd, "Meaningful Climate Science," *Climatic Change*, November 29, 2021, 17, https://doi.org/10.1007/s10584-021-03246-2.
96. M. Holbraad, "Turning a Corner: Preamble for 'The Relative Native' by Eduardo Viveiros de Castro," *HAU: Journal of Ethnographic Theory* 3, no. 3 (2013): 470, https://doi.org/10.14318/hau3.3.032.
97. Boeck and Devisch, "Ndembu, Luunda and Yaka Divination," 100.
98. Brian Massumi, "Potential Politics and the Primacy of Preemption," *Theory & Event* 10, no. 2 (2007), https://doi.org/10.1353/tae.2007.0066.
99. Ben Anderson, "Preemption, Precaution, Preparedness: Anticipatory Action and Future Geographies," *Progress in Human Geography* 34, no. 6 (December 2010): 782, https://doi.org/10.1177/0309132510362600.
100. Frédéric Neyrat, "Avant-propos sur les sociétés de clairvoyance: 'Le progrès consiste à être poussé en avant par la police' (Chesterton)," *Multitudes* 40, no. 1 (2010): 104–11, https://doi.org/10.3917/mult.040.0104.
101. Elena Esposito, *The Future of Futures: The Time of Money in Financing and Society* (Cheltenham: Edward Elgar, 2011), 180–81.
102. Descola, *Par-delà nature*, 398.
103. Tim Ingold and Hervé Gosselin, *Faire: Anthropologie, archéologie, art et architecture* (Bellevaux: Dehors, 2017), 230.