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Divisé en 4 parties (les prémisses, Warburg, les membres de l'Ecole, et lectures de Panofsky aujourd'hui), et à partir des textes de chercheurs français, allemands, québécois et brésiliens, une mise à plat de l'héritage du grand Maître fondateur de l'Histoire de l'Art comme science, et la première valorisation, hors l'Ecole de Warburg, de l'enseignement et l'intérêt profond et certain de Panofsky pour les chercheurs, universitaires, scientifiques et enseignants d'aujourd'hui, afin de donner un sens à l'Histoire de l'Art comme matière fondamentale de l'étude de l'Histoire des Mentalités et de leur évolution, synchronique et diachronique.

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THE NECESSITY OF EXOSOMATIC KNOWLEDGE FOR CIVILIZATION AND A REVISION TO OUR EPISTEMOLOGY

Dr. Ray Scott Percival
Assistant Professor
Department of Philosophy
Faculty of Humanities and Social Sciences
United Arab Emirates University

Biographie de l'auteur:
Obtained a degree in Psychology at The University of Bolton, England, a Masters in Philosophy at The University of Warwick, and a PhD in Philosophy at The London School of Economics. He is the founder and editor of The Karl Popper Web (1995) and he was the organizer of the Annual Conference on the Philosophy of Sir Karl Popper (1988 to 1998), both sponsored by the L.S.E and The Open Society Institute, New York. Taught philosophy of science at the University of Lancaster and, since 2004, has taught at the United Arab Emirates University, specializing in the philosophy of mind and the philosophy of science. Since 1994, has also published many articles and reviews for Nature, The New Scientist, Science Spectrum and The Times Higher Educational Supplement. His forthcoming book is The Myth of the Closed Mind. His YouTube channel is the NaiveRealist.

Résumé de l'article:
The traditional conception of knowledge is justified, true belief. This located knowledge within the person's mind. I argue that due to the explosive growth of what I like to call "exosomatic knowledge," knowledge outside the mind, the traditional conception has outlived its relevance. On the other hand, Karl Popper's (1934) Falsificationism, with its emphasis on the objective character of knowledge, is not only a sounder, but also a more appropriate theory of knowledge for understanding the nature and growth of civilization. I first argue that Popper's methodology is quite suited to the view that knowledge is an objective autonomous product and then briefly expound his theory of world 3, an ontology that neatly wraps up various considerations. World 3 is the domain of abstract products of the human mind that now have a life of their own: theories, arguments, problems, plans, etc. The great bulk of our knowledge and thus our civilization itself is a world 3 product, irreversibly alienated from our psychology.

"*For all is but a woven web of guesses*"
Xenophanes (570 – 480 BCE)

The traditional conception of knowledge is justified, true belief. If one looks at a modern textbook on epistemology, the great bulk of questions with which it deals are to do with personal knowledge, as embodied in beliefs and the proper experiences that someone ought to have had in order to have the right (or justification) to know. I intend to argue that due to the explosive growth of knowledge whose domain is "outside the head", this conception has outlived its relevance. On the other hand, Karl Popper's (1934) Falsificationism, with its emphasis on the objective character of knowledge, is not only a sounder, but also a more appropriate theory of knowledge for understanding the nature and growth of civilization. Falsificationism is Popper's answer to two fundamental problems of epistemology: the demarcation of science and the problem of induction. It rejects the idea of justifying theories as both impossible and unnecessary, and instead upholds the goal of truth. For induction Falsificationism substitutes a method of testing scientific theories by observation. Later, Popper (1945) generalized this approach to obtain critical rationalism, in which all claims to knowledge – whether scientific or otherwise - are understood as objective solutions to objective problems and can be evaluated by other – non-observational - types of criticism. I will first argue that Popper's methodology is quite suited to the view that knowledge is an objective autonomous product and then adduce his theory of world 3, an ontology that neatly wraps up various considerations. World 3 is the domain of abstract products of the human mind that now have a life of their own: theories, arguments, problems, plans, etc.

The history of exosomatic knowledge

Since Aristotle knowledge was conceived as justified, true belief. This implied that knowledge had to be part of human psychology. However, today, the great bulk of knowledge lies outside peoples' mind/brains. The invention of writing in ancient Mesopotamia and the emergence of the book were key moments in the externalisation of knowledge from the human body – exosomatic knowledge, or knowledge outside the body. The growth of computation, the invention of the Internet by Vince Cerf and others in the 60s and 70s, and the web by Tim Berners-Lee in the 90s, accelerated this development. One indicator of the staggering growth of exosomatic knowledge is the growth in the number of networked devises requiring an Internet Protocol address. On the Internet, every device has an address – computers, obviously, but also now cameras, smart phones, smart pens etc. The 4th version of the IP address, used since 1982, which allowed for 4 billion addresses, is already reaching exhaustion (*Infoworld* predicts that the IANA pool may be exhausted by the end of 2010), and now requires a rapid – some say, emergency - deployment of IPv6 to prevent disruption to the internet.

In contrast to these dramatic recent events, during much of the early history of Homo sapiens, lasting about 3 million years, all knowledge was almost purely psychological. All knowledge existed as either beliefs or skills trapped inside the human brain/mind.

Insofar as tools are a kind of externalised knowledge, there was exosomatic knowledge, but this amounted to extremely simple artefacts such as flaked quartz pebbles (the seemingly ironically named "Omo industrial complex," dating between 3 million 2 million years ago), often difficult to distinguish from naturally occurring rocks, up through the Oldowan stone tools, the hand axes (found at Konso Gardula in Ethiopia, dating 1.4 million years ago), which required several stages of production, to true blade technology in contrast to rough flakes, in which thin slivers of flint are fashioned into very sharp, often prismatic blades (found in the cave of Haua Fteah, North Africa, dating back to 100,000 years). It's clear that this period was an extremely slow development of hunting technology. However, about 40,000 years ago there was an explosion of cultural artefacts, as seen most dramatically in the Lascaux caves. The most impressive of these are in Europe, where beads, pendants, necklaces and human figures were fashioned from ivory and cave walls were painted with both abstract and naturalistic images. (Cf. Steven Mithen, 1999.)

This cultural explosion that started 40,000 years ago led to an accelerated growth in non-psychological or "exosomatic" knowledge. We have now reached a point where, even if we wanted to, we would not be able to re-embody this exosomatic knowledge in belief etc, due to the information storage limitations of the human brain. (Actually, this limit is not peculiar to the human brain: it's set by the bekenstein bound. The bekenstein bound is a physical limit on how much information can be stored in a given volume of space.)

This story has been one of the increasing alienation of knowledge from the body and mind and the increasing abstraction of knowledge to make knowledge more transmissible and malleable, making it serve more different purposes more efficiently. Most knowledge now exists outside the human body and mind.
Advanced industrial society cannot now even exist without this literally unthinkable knowledge. I deploy arguments to show this and show how this development forces us to revise our philosophical conception of knowledge.

Not only does this explosion of exosomatic knowledge break the tie with belief, but it also makes it easier to see knowledge as detached from the personal processes of justification that we associate with it. For example, a modern theory of justification is called Bayesian, which is a way of adjusting degree of belief according to evidence. But if knowledge really is an objective, non-psychological thing, then justification may be irrelevant. This will not lead us astray, so long as our goal is the improvement of knowledge and we employ methods for controlling error. In other words, we may return to an earlier conception of knowledge, that of the Pre-Socratics. It is at this point where Karl Popper's theory of falsificationism, and more generally, comprehensive critical rationalism, gives us a clearer view of knowledge that suits the alienated character of the overwhelming bulk of knowledge. Comprehensive critical rationalism holds that knowledge is an objective product of the human mind, but once produced, it has an independent existence, has unfathomable content, and can be more or less true. Truth takes the place of justification as the goal. The control of error in science is executed by severe observational tests in attempts to falsify hypotheses.

Context and Background to Popper's
Theory of Scientific Method

Falsificationism is Karl Popper's proposed methodology of science. It was proposed to answer what Popper took to be the two fundamental problems of the theory of knowledge. The first of these questions is how do we separate genuine science from non-scientific and pseudo scientific theories or activities? This is the demarcation problem. The second question is how do we promote the growth of knowledge?

Contemporaneous with Popper, the logical positivists had characterised scientific theories as all and only those theories capable of verification – showing a statement to be true by observation. This was a development of the empirical tradition in philosophy. The positivists put a great emphasis on verification. They even took verifiability to be the criterion of the meaning for any theory that purported to talk about the world. For example, the meaning of "iron dissolves in nitric acid" consists of the observations that one would perform in verifying it. (Mathematics and logic were regarded as a special case, being composed of tautologies, which do not talk about the world.) So all other statements – such as "there is an absolute spirit that rules the world", "everything is ultimately one", "there is an all-powerful being," "the world consists of number" - were classed as meaningless.

It looked like they had succeeded in excluding the arch examples of "metaphysical" and other unscientific ideas. However, a fundamental problem with their approach was that the principle of meaning itself looked suspiciously unverifiable. Just how would one verify "All and only verifiable statements have meaning?" The other devastating problem was that scientific theories, which by their universality, talk about the whole of space and time, are unverifiable too. The theory "no light can escape from a black hole" refers to all black holes, past present and future – even to those that did not, do not, and will not, but could have existed. It is hardly to be countenanced that all these could be observed – or even a decent "sample" – with infinite counterfactual possibilities, what would be a decent sample? So the positivists threw the baby out with the bath water. Valuable scientific theories were dumped on the same heap along with all the supposedly unscientific and meaningless utterances of humankind.

Popper shared with the logical positivists the quest to demarcate science from non-science and pseudo-science, but thought that the positivists' use of a criterion of meaning and their emphasis on verifiability were both deeply misleading. There are many meaningful theories that are unverifiable, such as the myths from which scientific theories develop, for example, Democritus' atomic theory of matter, which led to Dalton's testable theory of the atom. Popper pointed out that there are other ways of indicating that a theory has meaning, for example if two theories contradict one another, then they must both be meaningful. For example, Democritus' atomic theory contradicts any theory that asserts that matter is a continuous field of forces. The positivists made the very idea of writing intellectual history a meaningless activity. Democritus' theory is excluded by Popper's criterion, but Popper does not have to deny its intelligibility and so does not preclude intellectual history.

Popper's answer was that scientists should freely create competing bold conjectures about the general law-like structure of the world. They should then subject these to unrestrained criticism. The conjectures are statements whose logical form permits them to clash with observation statements obtained from controlled repeatable experiments; the criticism consists of decisive experiments that can decide between two or more theories by reference to the observation statements obtained. There is the proviso that the observation statements themselves be testable. Theories that can conceivably be shown to be false by such observation are falsifiable. Clearly from this perspective, a theory such as homeopathy is – though conceivably true – unfalsifiable and therefore unscientific. If it is wrong, we cannot show this and are therefore saddled with it indefinitely. The theory that iron dissolves in nitric acid is, by contrast, falsifiable; for all one needs is a single counter instance to contradict the universal statement – a single observation of some iron failing to dissolve. If this theory is wrong, then we can show it to be false and eject it from science. Democritus' theory, which states that at a sufficient depth of division matter cannot be divided any further, is – though a stimulus for later development – unfalsifiable. For, at any level of division – say a trillion divisions of a gram of aluminium – without hitting indivisible atoms – a die hard Democritean can always say that only shows that the atoms must be smaller. On the other hand, Dalton's atomic theory is falsifiable because it implies – among other things - the law of the conservation of mass, the law of definite proportions and the law of multiple proportions, any of which can clash with observation statements.

There are two valuable things about falsifiable theories. The first is that the more falsifiable they are, the more they tell us about the world. The argument for this is that a falsifiable theory is falsifiable on account of its prohibiting that range of states of affairs that, if true, would refute the theory. This fits well with our preference for precise and general theories over vague and less general theories. The more a theory is both precise and general, the more ranges of states of affairs it will prohibit. For example, the theory that all planets orbit their star in ellipses with the star at one foci prohibits more states of affairs than the theory that all the planets in our galaxy orbit their star with an elliptical path. Secondly, if a falsifiable theory were false, there is a way of refuting them and ejecting them from the body of what we provisionally classify as the body of truth or knowledge.

Popper (1945) later generalised this approach to all rational discussion in the form of Critical Rationalism. The idea here is that position can be discussed rationally. Even if non-scientific theories cannot be subjected to our toughest test of observational falsification, they can, nevertheless, be discussed. Why? The answer is that we can use other intellectual standards to act as the test, such as those of logical internal consistency, addressing the problem appropriately and consistency with scientific knowledge. Again, there is no presumption of justification because we are using the standard as something against which to match the proposed position: if it fails to match, it fails the test; if it matches, nothing follows. A key development in this approach was Popper's acceptance of W. W. Bartley's clear distinction between the goals of truth and justification. (See Realism and the Aim of Science.)

The Damage already done to Justificationism before Popper.

At least on empirical questions, justification was seen as an observation, which in turn was a controlled experience. In Francis Bacon's view, called induction, the world is conceived as an open book that the mind can read by repeated observations. We just have to be careful readers and avoid the biases of our prejudices. Bacon was trying to move away from the syllogistic method of the medieval schoolmen and defines his alternative procedure as one "which by slow and faithful toil gathers information from things and brings it into understanding." (Quoted by Farrington, 1964, page 89.) Inductivists assumed that the repetition of observation with variation produced and formed the premises for the inference to explanatory theories. The inductivist recipe was: first collect the data and then infer the corresponding general theories. However, inductivism was to encounter many fundamental problems.

David Hume (1739/40) fundamentally undermined the plausibility of this position. In an induction we are supposed to be able to infer from a great many observations of event B following event A, that B always follows A. For example, from the experience of seeing many objects with mass fall to Earth, we are supposed to be able to infer that all objects with mass would, under similar conditions, fall to Earth. We are at least assured, the inductivist insists, that our inference from what we have experienced to what we have not experienced grows more probable with each experience. Now in a valid deductive argument if the premises were true, then the conclusion must also be true. The point of deductive arguments is that the rules of inference will never lead you from true premises to false conclusions. For example:

1. All Kangaroos are animals with kidneys.
2. All animals with kidneys have a liver.
3. Therefore: All Kangaroos are animals with kidneys.

If the premises 1 and 2 were true, then the conclusion must also be true. The form of the argument is Barbara (All A is B; All B is C; therefore: All A is C). This does not obtain with so-called inductive arguments: the conclusion is allowed to be false.

Hume pointed out that in inductive inferences you could have true premises and a false conclusion and so are invalid by deductive standards. So what standards should one have for inductive inferences? If one retreats to mere increased probability for one's conclusions, this becomes implausible once one sees that the world has an inexhaustible –literally infinite – number of possible experiences or observations. What assures us, Hume chided the inductivist, that inductions in general will prove probable? The inductivist cannot use induction to prove induction or even make it a probably true because we have only performed a tiny finite number of all the infinite possible inductions.

I would add to Hume's deductive criticism. Even justificationists would accept that one should keep one's theories and methods open to critical evaluation. However, although deductive rules may be critically evaluated, inductive rules cannot. This may seem strange at first because, after all, isn't deduction above possible doubt and criticism? Let me elaborate. The concept of a valid argument provides two fundamentally useful possibilities. First, if the conclusion of a valid argument is false, that enables you to infer that at least one of the premises is false. Secondly, and perhaps even more importantly, the concept of a valid argument allows us to test the rule itself.

Many have tried to attack the purely deductive method of falsificationism by saying it has the same problem as induction – that you cannot justify deduction by deduction, since you have to presuppose the rules of deduction in using deduction. On the contrary, if the use of the form of an argument is found to lead us from true premises to a false conclusion, then we can infer (at least provisionally) that the rule is invalid. Any newly proposed rule of deduction can be tested in this way. On the other hand, newly proposed rules of inductive argument are impossible to test in a similar way, because (even from the inductivist point of view) the premises may be incontestably true but the conclusion incontestably false. No one has proposed a general rule that tells us exactly when to abandon any particular inductive rule. Falsificationism is purely deductive. Modus Ponens leads us from the theory to testable observable predictions, while Modus Tollens allows us to deduce the falsity of the theory from the falsity of the prediction. So falsificationism sets higher standards in terms of it own criticisability than does induction.

Falsificationism is by the same account more in line with the humility of our best example of deductive reasoning – mathematics. Mathematics has come to terms with what Morris Kline has called The Loss of Certainty. Even as late as early 20th century mathematicians, using rules of proof and concepts they thought unquestionable, were still trying to build indubitable foundations to mathematics. But shocking discoveries were at hand. At one time set-theoretic reasoning was accepted as indubitable. Frege even set about founding arithmetic upon it. Then Bertrand Russell discovered a contradiction in the foundations by asking about the set of all sets that do not belong to themselves. Such a question ought to have been acceptable. One clearly has sets that do not belong to themselves (e.g., the set of all red books is not a red book) and also sets that belong to themselves (e.g., the set of all sets with more than one member). Surely each of these groupings forms an untroubled set. The rules of set theory had to be modified. Under what circumstances would inductive reasoning be modified?

I surmise that the inductivist tends to think of the problem of getting to know the general law-like structure of the world as if it were equivalent to getting a good statistical report on the ratio of trout to salmon in a particular lake. In this contained and well-defined problem, we can get a good report because the domain to be sampled has self-contained and well-defined boundaries and we have some theories about the behaviour of salmon and trout and so can make good samples of the population. Therefore, the ratio in the sample is going to be close to the true ratio in the whole lake population. But when we are talking about samples of inductions in science in the infinite sea of possibilities, the very idea of a good sample collapses.

A more fundamental problem affects both induction (as a special case) and all justifications. The inductivist cannot rely on induction to justify induction, because he would immediately face an insurmountable dilemma. For a justificationist one should only adopt those positions that can be justified. However, every justification is an argument with premises. Now an argument is itself a position and therefore demands justification. If one demands that the premises must be justified, then one initiates an infinite regress of justification. On the other hand, if one stops at some point, one embraces a dogmatic position.

Falsificationism, and its more inclusive general approach, Critical Rationalism, does not face such a problem. Critical rationalism proposes the attitude: you may be right and I may be wrong, but with a little mutual criticism we may get nearer to the truth. This does not initiate an infinite regress of justifications because it does not presuppose that it can be justified. On the other hand, it sees truth as the goal of rational inquiry, not justification. It merely opens itself up for criticism, arguing that all positions – including itself - are in principle criticisable – but not necessarily successfully so. Therefore comprehensive critical rationalism avoids both infinite regress and dogmatism.

Some see the development of Bayesian probability and its application to induction as an answer to Hume. However, as Miller (1994) points out, an exclusive use of Bayesian theory neglects the main goal of science, which is not probability but truth. Truth and probable truth are very different creatures. Admittedly certain truth is truth, but only probable truth is not truth, and could only be a pale and boring substitute for the adventure of curiosity that we wish science to be.

Sensing the embarrassment of that inductive arguments have inconclusive conclusions, others have tried to introduce inductive principles or assumptions that somehow bridge the gap between particular finite premises and general conclusions. Musgrave is one of the champions of this approach. It's a surreptitious attempt to return to deduction. However, no one has proposed any such principle that has had any role in actual science.

The Excision of The Subjective Components of the Traditional Conception

If we are to advance this objectivist theory of knowledge as more appropriate to understanding the rise of civilization, then what is the fate of the components of the traditional conception?

In the old tri-partite conception of knowledge, two of the components are incontestably subjective: justification and belief.

Being largely within the empirical tradition, the justificationists rely on what they regard as an ultimate authority: untainted raw experience. This raises two fundamental problems. The first is that there really is no raw experience untainted by theory or expectation. For example, if I observe the boiling of a sample of water, my experience is laden with theory. For a start, the term "water" is a dispositional term, meaning that I expect (among an indefinite number of other things) that if the water were cooled, then it would return to a non-boiling state and that if it were reheated it would boil again. The second problem is, as Fries pointed out, even if there really are raw experiences devoid of theory, then we cannot use them as premises in justifying arguments. All arguments start from premises, but premises are statements, not raw experiences. The falsificationist solution to this is that we must resign ourselves to making risky observational reports of our experience, realizing that our observational reports must themselves be testable. But, being statements, they can be used in our Modus Tollens.

What of truth? If the goal of science – indeed all – intellectual enquiry is truth, how should we conceive it without bringing in subjective components? The major theories of truth are the correspondence theory, the pragmatic theory, the coherence theory and the various deflationary theories.

The goal of science is, I suggest, truth. But many philosophers have conceived it as a relation intrinsically involving the mind in the form of belief:

"I have never had any doubts about truth, because it seems a notion so transcendentally clear that nobody can be ignorant of it...the word 'truth', in the strict sense, denotes the conformity of thought with its object."
(Descartes, 1639.)

"The nominal definition of truth, that it is the agreement of [a cognition] with its object, is assumed as granted."
(Kant, 1787)

"Truth, as any dictionary will tell you, is a property of certain of our ideas. It means their 'agreement', as falsity means their disagreement, with 'reality'" (William James, 1907)

The problem with choosing belief as the truth bearer is that belief is an ephemeral and mercurial process. It would be far better to link truth to language as an objective, autonomous and permanent product of the human mind.

Theories of Truth and their Compatibility with an Objectivist Conception of Knowledge.

Lets look briefly at the various theories of truth to see how compatible they are with an objective conception of knowledge. The pragmatic theory of truth is, in a way, suited to an objective theory of knowledge, because it could be unpacked as procedures or techniques for manipulating the world to achieve practical goals. However, it excludes far too much of what constitutes the exosomatic knowledge upon which our civilization depends. Large areas of mathematics, for example, may not have any use outside of mathematical explorations, but it's a risky business knowing for sure whether and how extremely abstruse structures will be used in the future for non-mathematical purposes. It also fails to account for the universality of the truth of laws of nature. They cannot be reduced to simply useful rules, for useful rules are still valid even if confined to a given range of application; but a proposed law of nature is false if it meets but one counterexample.

The coherence theory truth is always presented as a coherence of beliefs. However, the coherence theory of truth is also suited in some respect for an objective conception of knowledge because the logical relationships of compatibility or interdeducibility can be conceived as autonomous from the human mind. I other words, one could speak of a coherent system of statements or theories. But coherence is a pale substitute for the real growth of knowledge which must go beyond what we already know and connect in some sense with a world that is not of our making.

In contrast to the above philosophers, I would like to argue that truth could be conceived independently of personal knowledge. As an approximation, I accept the Aristotelian conception, that a proposition is true if and only if it corresponds to the facts: "To say of what is that it is not, or of what is not that it is, is false, while to say of what is that it is, and of what is not that it is not, is true." (Metaphysics, part 7, Book IV.) Aristotle's definition does not limit the notion to the mind; it is general enough to cover both the subjective mind and truth as applied to language.

It can be argued that Tarski helped us to see that truth can be conceived without much difficulty as a relationship between objective linguistic entities (statements) and states of affairs in the world. The relationship for any given language is described in a metalanguage. Thus if we wish to describe the truth of the sentence "Snow is white", we say: The sentence "snow is white" is true if and only if snow is white. The only terms of the relationship are the sentence and the state of affairs (described in the object language), and therefore the psychology of the subject who may have produced the sentence is irrelevant. As Frege would say, there is a distinction between the thought (snow is white) as a mental state and the thought (snow is white) as the propositional content, which can be embodied in the sentence.

Of course, there is still debate about the relation that we call correspondence

Since Tarski there have been many so-called "deflationary" accounts of truth that have exploited the so-called equivalence schema: <A> is true if and only if A. (Where <A> is a quoted statement A.) (Cf. Bradley P. Armour-Garb and J.C .Beall eds., 2005.) All deflationary theories – minimalist, disquotationalist and prosententialism - concur in presenting truth as an object characteristic of language, not a psychological state or process. Influenced by a Wittgensteinian approach to philosophical problems, deflationary theories exclusively focus on the use of the predicate "true." Wittgenstein made proclaimed that there were no real philosophical problems, just confusions about language use. The deflationists want to argue that there is nothing more to the concept and property of truth than is captured by the equivalence schema.

But I would argue that perhaps they have gone too far and reduced the notion of truth to a mere convenience of reference. For example, it is pointed out that saying "it is true that P" is equivalent to saying P. That equivalence enables us to say many things that we could not say without the truth predicate such as "all the statements in this book are true." and "if the axioms of this geometry are true, then so are all the infinite number of its logical consequences." But I feel that, though correct about the practical usefulness of the truth predicate in his respect, we also use it to point to one of the most important goals of intellectual adventure in science and elsewhere: our desire for truth. We want the truths about black holes, dark matter and dark energy. This is more than a desire for some theories that one can quote and disquote, it is a desire for true theories – to know something beyond our theories. We want to know if our theories somehow match an external reality that is not of our making. Many of these truths have yet to be discovered or even conjectured. Therefore, I would suggest that the usefulness of the truth predicate in abbreviating reference is trivial compared to these interests.

But the main point here is that even if we concede to the deflationary view of truth, it is still an objective characteristic of linguistic abbreviation and reference, not a psychological state or disposition.

I have argued that an objectivist non-personal conception of knowledge is adequate for the methodology of our best example of self-critical intellectual adventure: science. I have also argued that we only need one of the components of the traditional conception: truth. Having dealt with methodology, we may wish to ask what kind of ontology would be most suitable the exosomatic character of our civilization? I would argue that Popper's theory of world 3 is a fascinating answer.

Popper's World 3.

Karl Popper (1972, p. 106) argued that the world can be usefully divided into 3 worlds or domains. The most obvious one is the physical world of chairs, oceans, planets and quarks, world 1. World 2 is the world of the mind: ideas, dreams, expectations, feelings. Popper suggests that there is further domain. World 3 is the world of abstract products of the human mind which now have an autonomous existence. Popper cites Bernard Bolzano's "sentences in themselves" and Frege's "thought contents" as a starting point for world 3. Humans have created theories, arguments, proofs, designs for engines and problems, etc. However, once these structures have been created, they are in many interesting ways autonomous. They have their own types of non-psychological properties and relations with one another. For example, one theory may logically entail or contradict another, but this was no part of the psychology of the creators of these theories. In addition the contents of world 3 influence our thinking in ways that are unpredictable from knowledge solely of the psychology (world 2) of the persons who created them. Popper's view is therefore an example of emergent materialism, in which earlier forms evolve and give rise to emergent properties and structures that then exercise plastic control over their ancestral structures. Thus for Popper, the mind is an emergent structure from the physical world, and abstract entities are emergent structures from the mind.

The contents of world 3 are like a new design for a Saab engine. The engine was once the creature of the designer's mind – something he lived with, slept with ate with, etc. But now it can be placed on a table and other engineers can gather round to inspect and evaluate its structure and function without knowing anything at all about the designer. New types of number system have properties that go beyond our full grasp and can only be discovered by inspecting the system with logical means, not by inspecting the mathematician's mind. Popper also included in world 3 works of art, music and even institutions.

The view is consistent with Popper's evolutionary view of humans, in which a beaver's dam, a bird's nest and a spider's web are biological homologues of human cities and other (at least partly) autonomous structures. Incidentally, for examples of the unintended autonomous properties of cities see Jane Jacobs (1961). Popper's theory should be distinguished from social constructivism. Society and civilization, considered as world 3 structures created by social interaction, as social constructivism maintains, but they are not reducible to the collective of interacting minds and/or behaviour. Consider, for example, The Royal Society as a world 3 object. The Society is governed by its Council, which is chaired by the Society's President, according to a set of Statutes and Standing Orders. The members of the Council and the President are elected from and by its Fellows, who are themselves elected by existing Fellows. Obviously, without the social behaviour of its members, this society, founded in 1660, would be ineffective. But the statutes and other rules of the society, undeniably abstract entities, cannot be reduced to the set of all the members' behaviour since its foundation. But without reference to these various rules, in both their actual and "potential" use, we cannot make sense of the society.

A notable criticism of Popper's world 3 should first be disposed. O'Hear (1980) attacked the idea of a new realm by saying that we ought to see numbers, for example, as inseparable from our rules of calculation. The idea here is that we should try to reduce abstract entities to procedures in following rules. However, Godel's incompleteness theorem tells us that if arithmetic is consistent, then there must be true statements of arithmetic that we cannot prove – numbers that are ineluctably separate from our rules and procedures.

Arguments for the Autonomy and Objectivity of Knowledge and Meaning.

Now I would like to expound 5 independent main arguments for the idea that an objective conception of knowledge is far more appropriate for understanding our civilisation. Some are based on Popper's arguments with personal elaborations (1 & 5); some are new arguments (1, 3 & 4).

 # 1. Argument from Information Theory.

Someone might quibble about my representing the early developments of human technology as the development of knowledge. However, if tools and methods can be represented as information and information as a kind of knowledge, then tools can also be represented as knowledge. There is an important argument in the theory of computation that concludes that any mechanical series of actions (say of a machine or tool) can be simulated by a computer program, and since a computer program is a pattern of information, it follows that tools can be represented as patterns of information. The mathematician Roger Penrose (1989) suggested that the computation principle be called the Turing Principle, as it derives from the development of Turing's fundamental work. Penrose states the conjecture thus: There exists an abstract universal computer whose repertoire includes any computation that any physically possible object can perform.

At one time only the human mind could be said to hold information. However, since the rise of information theory, it has become plausible to describe physical systems as embodying information, the best example being the chemical strand called a gene. We feel comfortable saying that the gene has the information or knowledge for building and maintaining an organism.

 # 2. Argument from the Unfathomable Depths of Knowledge.

Just consider two books in widely separated libraries – say the University of Warwick library, U.K. and the Zayed Library, U.A.E. No one has read both of these books. Now these books might be talking about the same issues and so what they say would have logical relationships with one another. Suppose they contain theories that contradict one another. If someone were to read the books and state this relationship explicitly, then this would add to our knowledge in some respect - it would be a kind of commentary on the body of knowledge in the libraries of the world. But in another sense, it would not be adding anything because those relationships already existed to be commented on. More to the point, those relationships were a property of the exosomatic knowledge, not of our psychology.

One of the remarkable things about Euclidean geometry is the fact that many unexpected theorems can be derived from a relatively small set of axioms and definitions. This must have formed part of the charm of Euclid's Elements since its creation. But if we look more closely, the surprising extent of what lies unfathomed in our explicit formulations becomes astounding.

The theories that we create have infinitely more content than we will ever know. Theories have ramifications and logical implications that are literally infinite and therefore unfathomable to their creators. Bartley (1990) stressed the importance of this aspect of theories. The implications of a theory are part of the knowledge contained in that theory. Therefore, an infinite amount of the knowledge contained in our theories is unfathomable, unknowable in a subjective or personal sense. An important sense of the meaning of a theory is all the theories that are logically incompatible with that theory. For example, suppose I say that it will be rainy and 40 degrees centigrade today in Dubai. Part of the meaning of this statement is that it is false that the weather in Dubai today will be dry and 35 degrees centigrade, and also that it is false that it will be dry and 20 degrees. You can easily construct an indefinite number of logically incompatible statements. The same holds for other theories whose incompatibility may be much less clear, as the ramifications would take much effort to work out. But whether they are worked out or not, those incompatible statements exist. The technical term for this infinite class of statements is the information content of the theory or statement.

To illustrate this concept in science, Popper used the example of Newton's theory. Newton's theory is strictly incompatible with – contradicts – Einstein's theory. Newton could not have foreseen Einstein's theory, yet there is a logical relationship between the two theories and Einstein's theory is part of the information content of Newton's theory. It is therefore part of the meaning and knowledge of Newton's theory. The same holds for all scientific theories that rival one another. Further, for any extant scientific theory there are an indefinite number of possible future theories that – though they have yet to see the light of day - are part of the theory's information content.

 # 3. Argument from Ancient Indecipherable Texts

Archaeologists have discovered what might be conjectured to be systems of writing for which there is no translation. Some such systems – such as that found on the famous Rosetta Stone – seemed at first beyond translation and resisted attempts for years, but later succumbed to persistent and clever efforts. But these ancient systems raise the question could there possibly be a system that resists all attempts – maybe all possible attempts – at decipherment?

For example, the Jiahu symbols (贾湖契刻符号) refer to the 16 distinct markings on prehistoric artefacts found in Jiahu, a Neolithic Peiligang culture site found in Henan, China. Dated to 6600 BC, some archaeologists believe the markings to be a writing system related to the oracle bone script (e.g. similar markings of 目 "eye", 日 "sun; day"). Of course, in this case, there may be insufficient material to work with, making it practically impossible to translate in a manner that would permit us to test the conjectured translation. But this would be a limitation of our ability to construct falsifying tests, and does not imply that it was not part of a language with meaning or knowledge. A justificationist faced with such ancient markings might feel forced to label the material nonsense, because there is hardly any possibility of verifying the proposal that it may be a language and meaning for a justificationist is often defined by verification.

 # 4. Argument from lost Encryption Key.

Encryption is the process of turning an intelligible message into a form that looks like gibberish to people who lack the algorithm to turn it back into a readable message. One of the most famous of these algorithms was that embodied in the Enigma machine used by the Nazis to make their military communications secret. Without the key to decrypt a message, it is theoretically possible to decrypt it by what is known as a brute force attack: using powerful computers to run through all the possibilities until it reaches the right key. The number of possible combinations that form the key is extremely large. Today we have the technology to encrypt messages in forms that would resist decryption by the brute force for thousands or even millions of years.

Now suppose a book never read by anyone (except the author) was encrypted using a one-time pad. (One-time pad methods of encryption have been proved to be theoretically impossible to crack.) But then the encryption key was lost. Now what are we to say about the meaning and knowledge contained in the book? The book clearly had meaning before it was encrypted. And, although no one without the key could have read it, no one would claim that the book was meaningless in its encrypted state. But it is now beyond the reach of anyone's mind; it is an object with objective meaning and knowledge. You could strengthen this example by choosing a book written by a computer – for example, a book of logarithms or other mathematical tables – which no one had a chance to read before it was encrypted. In the latter case, there is a program that produced the book, which could be applied again to produce a copy. But suppose the same lost key also encrypted this program? We can also suppose that the programmer who created the program also suffered an untimely demise, and that there is no record of his thinking while creating this program.

Someone might object that if some supposed knowledge is useless, it is not really knowledge. This, in a nutshell, is the pragmatic theory of truth. If some supposed knowledge is inaccessible, then it is useless. The encrypted book is inaccessible. Therefore, the encrypted book is not knowledge. But usefulness, meaning and knowledge are clearly distinguishable concepts. There are mathematical theories that – at the time of their creation – were thought to be only intellectual adventures with no practical import, but were later found to be of essential use in scientific theories. Non-Euclidean geometries provide a good example. Bernhard Riemann, in a famous lecture in 1854, founded the field of

Riemannian geometry, discussing manifolds, Riemannian metric, and curvature. This mathematical knowledge had its own deep delight for pure curiosity. It was not until the 20th century with Einstein's theory of relativity that it became useful in more than an abstract delight – not to belittle intellectual delight, of course! I think that even if the book were never to be deciphered – or stronger – even if we knew that the world was such that it was physically impossible that it could ever be deciphered, it would still constitute knowledge.

 # 5. Argument from the Collapse of Civilization.

A Thought Experiment: 2 Imaginary Futures

To put into relief just how important and alienated the great bulk of our knowledge is, I have crafted two thought experiments, two hypothetical futures, A and B. These thought experiments are elaborations of the thought experiment described by Popper (1945 and 1972). I have made some rough conjectures about the actual amount of information that may be lost in each scenario. For the meaning of the terms of information measures, please consult table 1 in the appendix.

Future A.

At 7.20 pm on the 12 March, 2013 an experimental mind virus is accidentally released from a military research laboratory at Porton Down, Wilture, U.K. It was designed to disable the technical "belief- knowledge" of enemy armies.

•Within 2 weeks it has spread around the world.
•All technical knowledge is erased from human minds (apart from knowing how to read). Landauer (1986) estimated that each person stores in long term memory the equivalent of 227 megabytes. This represents about 2 meters of shelved books-worth of information per person. If this were true, then the 6 billion people on the planet would lose a total of 6 billion × 200 mb = 1,200 petabytes of information.
•Fortunately, Porton Down also developed an anti-dote, which restores the ability to learn technical facts.

Possible Long-Term Consequence:
(I) Civil unrest, panic, some wars.
(ii) 5 to 7 years of relearning how to learn and use the non-belief knowledge in libraries, computers (including the web). I have chosen 5 to 7 years as close to the average length of degree courses.
(iii) Within 5-7 years: Re-establishment of civilisation, nation-states and/or the creation of new ones.

Future B.

For many years Aliens have been watching the development of humans with concern. They would rather avoid having us as rivals in space.
At 7.20 pm on the 12 March, 2013 they do 2 things:
(i) They introduce a computer virus into all earth computers.
(ii) They destroy all the books of the world's libraries by introducing a ravenous paper-eating bug.

•All data is erased from all Earth computers and digital storage.
•All books are lost (including maps, movies, pictures, audio).
Estimated loss: All U.S. academic research libraries=2 petabytes; all printed material =200 petabytes.

The volumes of knowledge at stake is staggering. To illustrate, consider that the total volume of information produced just in 1999 = 2 exabytes. Between 1999 and 2002 new stored information has grown at about 30% per year.

Possible Long-Term Consequence:
(i) Civil unrest, panic, some wars.
(ii) I conjecture it would take at least 20 to 30 years of restoring and redeveloping exosomatic knowledge in libraries, computers (including the web). Much of this knowledge would be impossible to restore, for example, unique productions of art: paintings, photographs and audio of historical events, performances or views.
(iv) Possibly, the re-establishment of civilisation, nation-states and/or the creation of new ones.

I think its clear from these thought experiments that the loss of exosomatic knowledge would be more devastating than the loss of subjective technical knowledge. We are producing exosomatic knowledge and digital storage space more rapidly than we are producing human brain-storage space. Therefore, even if we haven't reach this point yet, there must come a time when exosomatic knowledge outstrips the capacity of all human brains. (The human population is predicted to stabilize at about 10 Billion by 2050.)

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Note: I would like to thank my friend, John Ashcroft-Jones for useful conversations on the problem of this chapter.

APPENDIX

Table 1.

Multiples of bytes					
SI decimal prefixes				IEC binary prefixes	
Name (Symbol)	Standard SI	Binary usage	Ratio SI/Binary	Name (Symbol)	Value
kilobyte (kB)	10^{3}	2^{10}	0.9766	kibibyte (KiB)	2^{10}
megabyte (MB)	10^{6}	2^{20}	0.9537	mebibyte (MiB)	2^{20}
gigabyte (GB)	10^{9}	2^{30}	0.9313	gibibyte (GiB)	2^{30}
terabyte (TB)	10^{12}	2^{40}	0.9095	tebibyte (TiB)	2^{40}
petabyte (PB)	10^{15}	2^{50}	0.8882	pebibyte (PiB)	2^{50}
exabyte (EB)	10^{18}	2^{60}	0.8674	exbibyte (EiB)	2^{60}
zettabyte (ZB)	10^{21}	2^{70}	0.8470	zebibyte (ZiB)	2^{70}
yottabyte (YB)	10^{24}	2^{80}	0.8272	yobibyte (YiB)	2^{80}