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Comptes Rendus de l'Académie Internationale de Philosophie des Sciences

Tome IV

The Relevance of Judgment for Philosophy of Science

Éditeur
Jure Zovko

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Jure Zovko

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Preface

The papers in this volume are revised versions of presentations delivered at the annual conference of the *Académie Internationale de Philosophie des Sciences* (Brussels), held during the COVID pandemic at the University of Zadar, in Croatia, from 12 to 16 October 2021. Of the fifteen conference participants, ten prepared their presentations for publication. Due to the risks posed by COVID, AIPS members Mario Alai, Reinhard Kahle, and Fabio Minazzi, as well as invited speakers Johan van Benthem and Chen Bo, gave their talks online.

The conference title, *"The Relevance of Judgment for Philosophy of Science"*, was formulated in close connection with my research project *"Hermeneutical Relevance of Judgment"* (2016–2020), funded by the Croatian Science Foundation. The Croatian Science Foundation also supported this conference, and I wish to extend special thanks to the Foundation's then-president, Prof. Nikola Ružinski.

I am equally grateful to the then-president of the Académie Internationale de Philosophie des Sciences, Prof. Gerhard Heinzmann, for generously endorsing both the proposed theme and the choice of venue at the University of Zadar. This was especially significant given that the phenomenon of judgment has often been overlooked within the Philosophy of Science. I was personally surprised by the enthusiasm with which the theme was embraced at the conference; despite the physical distancing mandated by the regulations of the Ministry of Health of the Republic of Croatia and the University of Zadar, a remarkable sense of closeness and a form of communicative sociability emerged among the participants. Regrettably, the thoughts and opinions expressed by the conference participants during the discussions were not documented. As a gesture of appreciation to the participants, the program is nevertheless presented here.

Wednesday, 13 October 2021.

9.00–9.15. Welcome of Participants. Ceremonial Hall of the University of Zadar. Dijana Vican, President of the University of Zadar. Marko Vučetić, Head of the Department of Philosophy. Gerhard Heinzmann, President of the AIPS.

9.15–10.00. Jure Zovko. *The role of judgment in scientific method.*

10.00–10.45. Michel Ghins. *The relevance of judgment for philosophy of science.*

10.45–11.00. Coffee Break.

11.00–11.45. Evandro Agazzi. *The ontological commitment of judgment in science.*

11.45–12.30. Alberto Cordero. *Judgment and diachronic assessment in objective science.*

12.30–13.45. Lunch Break.

13.45–14.30. Jean-Guy Meunier (online). *Conceptual models and judgement in computer engineering sciences.*

14.30–15.15. Mario Alai (online). *How should we judge current scientific theories?*

15.15–15.30. Coffee Break.

15.30–16.15. Johan van Benthem (online). *The surplus of judgment in logic.*

16.15–17.00. Gerhard Heinzmann. *The relevance of judgment for mathematical reasoning: Poincaré against the logicians, revisited.*

19.30. Dinner.

Thursday, 14 October 2021.

9.30–10.15. James McAllister. *The role of emotion in scientists' judgement: a rationalist account.*

10.15–11.00. Gino Tarozzi. *Does neo-empiricist refutation of Kant's synthetic a priori judgments rule out the possibility of meaningful philosophical principles?*

11.00–11.15. Coffee Break.

11.15–12.00. Fabio Minazzi. *Epistemology, axiology and scientific knowledge.*

12.00–12.45. Hans-Peter Grosshans. *Judgment in hermeneutics.*

12.45–14.30. Lunch Break.

14.30–15.15. Reinhard Kahle. *The question "why?".*

15.15–16.00. Lorenzo Magnani (online). *Discoverability in scientific abductive cognition.*

16.00–16.45. Jean Petitot (online). *The notion of "alternative judgment" in Kant's phoronomy.*

16.45–17.00. Coffee Break.

17.00–19.00. General Assembly.

20.00. Gala dinner.

Friday, 15 October 2021.

9.00–9.45. Bo Chen (online). *On Quine's naturalism.*

9.45–10.30. Bernard Feltz. *Language, causality, neuroscience and free will.*

10.30–10.45. Coffee Break.

10.45–11.30. Pedrag Šustar. *The knowability of biological laws.*

11.30–12.15. Dennis Dieks. *Judgments and perspectives in natural science.*

Interest in the phenomenon of judgment within the philosophy of science has become increasingly prominent. Already in 2022, at the conference of the Academy in Pavia, organized by our colleague Lorenzo Magnani at the Department of Humanities, University of Pavia, the chosen theme was Justification, Creativity, and Discoverability in Science. More recently, at the annual AIPS conference in Rome, held within the framework of the World Congress of Philosophy (August

1–4, 2024), the theme was Scientific Understanding. In the days of Ernest Nagel, Carl Gustav Hempel, and Karl Popper, it would have been difficult to imagine that an academy for the philosophy of science would hold an annual conference on the topic of "scientific understanding," because the intellectual activity of understanding was limited to the humanities, while philosophy of science primarily focused on discussion of explanation. Understanding, as an activity of the mind, was excluded from methodological argumentation by most representatives of the philosophy of science because it was thought to contain subjective statements and opinions lacking objective validity.

Terms such as *understanding* and *comprehensible* did not belong to the vocabulary of distinguished scholars of the philosophy of science half a century ago, since they refer to the psychological and subjective aspects of explanation.

The metaphor of the judge was a favorite theme of Kant's philosophy of science, it is a vivid example of how the human capacity for criticism and judgment can be integrated into the scientific understanding and explanation of phenomena in the context of the laws of nature. This ability to judge should be practiced and constantly improved, both as an applicative activity of the existing laws to concrete cases and as a reflective power of judgment in which the appropriate law is investigated. Similarly, Pierre Duhem claims that in the choice of a scientific hypothesis, the spirit of refinement (*l'esprit de finesse*) and elegance plays a decisive role, not the spirit of logical and geometrical exactness, it is a question of prudent judgment (*bon sens*): "To judge correctly the agreement of some physical theories with the facts, it is not enough to be a good mathematician and a skilful experimenter, but it is necessary to be an impartial and just judge." (Duhem, *La Théorie physique*, p. 357).

It is my hope that this volume, which examines the phenomenon of judgment along with its epistemic and ethical dimensions across different areas of the philosophy of science, will find a fruitful reception within the academic community of the philosophy of science.

Zadar J.Z.
August 2025

How should we judge current scientific theories?

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1 Two equally wrong extreme views

The scientific realism-antirealism debate concerns theories in general. However, as soon as the discussion draws arguments from the historical development of science, some issues emerge concerning how we should regard current theories in particular, as opposed to past and future ones.

Positions here range between two extremes: on the one hand, a radical version of the pessimistic meta-induction would have it that since all past theories older than 100–150 years or so have been proven radically false and rejected, all present and future theories will also be rejected within 100–150 years or so. Consequently, in science there can be no truth but, at most, empirical adequacy or the like.

On the opposite, Fahrbach (2011) stressed that in the 20^{th} century science has undergone an exponential quantitative and qualitative improvement as to the number and education of researchers, methodology, instruments, facilities, funding, available data, and communication; all of this makes the theories of the last 100 years or so dramatically different and incomparable with those of all the past centuries. Thus, some radical optimists like Doppelt (2007, 2011, 2014) or Park (2017b, 2018) hold that current best theories are almost completely and exactly true, and that further progress, besides adding new knowledge, can at best correct minor details of present day theories: they will not be refuted, because they have a "unique status" in the history of their discipline, distinguishing them from the older theories, and they "stand alone at the pinnacle of the entire field of inquiry" (Doppelt 2014, p. 285). For instance, "no scientific revolution will oust the special theory of relativity, and the special theory of relativity will only be augmented by infinitely many unconceived methods. Hence, there is no need to distinguish between stable and unstable posits of the special theory of relativity" (Park 2017a, p. 8).

Evidence, however, is against both extremes. To begin with, consider extreme pessimism: it cannot explain why even the ancient and now rejected theories were predictively successful: some of their predictions were as precise as utterly unforeseen and unforeseeable; therefore, they couldn't be gotten right by chance, except by a miraculous coincidence. The only plausible explanation of those successful achievements is that those theories had some

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M. Alai, How should we judge current scientific theories?, pp. 1–15.

true components which were sufficient to derive their predictions; current research in history and philosophy of science has spotted many of those components and shown that they are still accepted today.[1] Therefore, the best past theories were not *completely* false. Thus, one cannot inductively conclude that current theories are completely false: the pessimistic meta-induction is based on a wrong premise. Moreover, radical pessimism cannot explain the rapidly increasing rate of success of science, which instead is explained by the assumption that the true components of older theories are typically preserved in current ones.

As for the opposite extreme, it is implausible that *just now* we have reached the "end of history" in scientific research, a sort of promised land of pure truths, or Peirce's ideal limit of research, and that our science is infallible. While we see the mistakes of past science, obviously we cannot see those of present science, and this produces the illusion that there are none. But even in the past, age after age, people have been victims of the same illusion, which was then regularly deluded: in the 18^{th} century they thought Newton had finally and definitely discovered God's blueprint of the Universe. In 1874 Philipp von Jolly advised a young Max Planck against studying physics, because "In this field, almost everything is already discovered, and all that remains is to fill a few holes" (Lightman 2005, p. 8). In addition, we positively know that there are mistakes in current theories, because even two of the most successful ones, quantum mechanics and relativity, are at variance with one another and are beset by unsolved riddles. Besides, many important fundamental problems are still unsolved, and we still lack a grand unified theory: therefore, we are not at the end of the road, yet, and future research will introduce basic changes in currently accepted views.

> Why should we think that today's best science is true when past scientists believed the same of their science—which we reject today as badly wrong? The answer some strong realists give is that today's science is now mature, whereas theirs was not. After all, we now know of flaws in their theories, their instrumentation, their experimental design, their goals and standards, etc. But wait! What is to keep our distant successors from saying the same about us? Just because today's most successful theoretical claims seem practically flawless to us does not mean that they really are (Nickles 2017, p. 153).

No doubt, contemporary science has made astonishing progress with respect to past science. Nonetheless, even in the past the quantity of available data had increased steadily, better and better instruments had been introduced, methodology had progressively improved: for instance, there had been unquestionable progress from the year 1000 AD to 1700 AD, yet many wrong theories were still held at that date, and even thereafter. So, it is hard

[1] Psillos (1999), Alai (2018), Alai (2021).

to think that any improvement of background empirical knowledge, methods and technology can at some point make scientists practically infallible, and it is even more difficult to believe that *we* have already reached that point.

Moreover, Brad Wray pointed out that, just like at any time there are unconceived alternatives to the current theories (Stanford 2006), there are also unconceived methods and instruments, by which those theories could be overthrown: for instance, the discovery of the astronomical telescope contributed to the rejection of geocentrism and the discovery of the microscope undermined the theories of spontaneous generation.[2] Such methodological and technological advances are themselves largely the product of scientific progress. Hence, the very excellence of contemporary science will probably yield even newer methods and instruments, which in turn will likely undermine today's theories.

2 Revolutions ahead

The history of science has witnessed many ruptures, or "revolutions", and we may expect that this keep happening even in the future, for both subjective and objective reasons. On the one hand, in fact, scientists are still humans, using the same fundamental cognitive tools (reason and the five senses), and subject to the same cognitive limits; besides, scientific method is not radically different from the past. On the other hand, nature itself, contrary to accepted wisdom, makes jumps and has ruptures, because it is very complex and because it works in different ways at different scales and at different locations in space or time.For instance, nature is (roughly) deterministic at large scales, but indeterministic at small scales; the physical laws today are probably different from those a few instants after the Big Bang; entropy increases over time in the universe as a whole, but it may decrease in local areas or over short time spans; etc.[3]

Humans start their inquiry about nature from the time and area in which they are located, and from the scale of magnitude and range of energies to which they have most direct access. However, as they move forward to explore what lies farther in space or time, or what happens at different scales and ranges of energies, often what they have learned about their earlier targets is no longer valid for the new targets. This may happen just because the new targets have a different nature or work in a different way, so what we discover about them is simply added to what we knew about the old targets, as information about different subjects. Otherwise, it may be the case that even our earlier targets actually had this newly discovered nature or worked in the newly discovered ways, but we could not notice it from our earlier restricted location or on that earlier scale.

[2]Wray (2016), Park (2017a, §2).
[3]Alai (2017, p. 3282).

For instance, the principle of inertia works on the Earth just like in empty space, but due to the ubiquitous presence of friction it was recognized only with great difficulty; similarly, mass varies with velocity, but this could not be appreciated at ordinary velocities. So, by extending our research to different scales or locations we may learn that our previous theories were strictly speaking wrong: for instance, we discovered that there is no gravitational attraction at distance, that mass is not unalterable, and that there is no radical opposition between matter and energy.

What we learned at the previous scales or locations may still be approximately correct within those limits, not only at the empirical level, but also at the theoretical level: for instance, the planetary model of the atom is still an approximately true description of the unobservable behavior of the atom within a certain range of phenomena. Yet, in these cases the old models are replaced by, and embedded into, radically different models, which explain the success of the old theories and show which of their assumptions were true and which were false. For instance, the heliocentric model supplanted the geocentric one, and the curvature of space supplanted gravitational attraction.

Although we have already greatly expanded our understanding of nature, there are still undiscovered territories in front of us (think, for instance, of dark matter and energy). Therefore, like in the past, any breakthrough into a new location, scale or range of energy will probably teach us about some new fundamental features of nature, showing that current theories have certain basic mistakes and must be substituted by more fundamental and comprehensive accounts. In fact, the increasingly powerful resources of current science may make such revolutionary changes even more frequent than in the past.

On the other hand, as we proceed farther and farther from the areas, scales, and ranges of energies with which are more familiar, research becomes more and more difficult and demanding. For instance, the energies required to probe more and more basic particles, or earlier and earlier states of the universe, grow exponentially, up to the point of escaping present or foreseeable technology. Therefore, even the unprecedented improvement of our scientific resources and methods is insufficient to get us a completely safe grasp of the phenomena on today's frontiers of research and to assure that current theories won't be superseded.

Hence, the extraordinary rate of progress of contemporary science allows to block the pessimistic meta-inductive conclusion that current theories are completely false, but it does not show that they are immune from revision or substitution.[4] Every great advancement in science has uncovered a new unsuspected, deeper and more basic layer of the structure of nature, and

[4]Alai (2017, pp. 3282–3283).

we don't know how many of those still lie ahead. Each of those discoveries exposed some basic mistake in our understanding of certain mechanisms of nature, spurring a big or small revolution, and nothing says we have probed all of this unfathomable complexity, yet.

3 A moderate intermediate view

Therefore, there are good arguments against both extreme pessimism and extreme optimism. Moreover, these arguments are mutually compatible and converge in suggesting a moderate intermediate position: current theories are partly true, in fact more (perhaps much more) largely true than past theories, yet probably they still include important false components. Those false components may be replaced by future revolutionary changes, like Newton's absolute space and time and gravitational theory were replaced by Einstein's spacetime and by its curvature, or the dichotomy of matter and energy, still surviving in late 19^{th}-century electromagnetism and statistical mechanics, was replaced by the convertibility of one into the other in quantum mechanics and special relativity. Contrary to Kuhn's view, revolutions and progress go hand in hand.

Induction as such is a good inference pattern, and it can be correctly applied to past science, on condition of taking a correct image of past science as a premise. If this is done, the conclusion is a more balanced judgment of current and future theories, neither completely pessimistic nor implausibly optimistic. What we observe in past science is that (1) every theory has been found to be (partly) mistaken and replaced; yet (2) mistaken but predictively successful theories had some true components (those essential to derive their successful novel predictions); moreover, (3) those components were typically preserved in subsequent theories, which therefore were more largely true.

Since there is no reason to deny that this will keep happening, we should conclude that current theories are more largely true than earlier ones, but still partly false. Even if not all the innovations and changes introduced by current theories are probably true and will be preserved in the future, still we can appreciate and evaluate one by one many new pieces of information and many corrections introduced by current theories.

4 Can we discriminate truth from falsity?

According to Psillos' (1999) *deployment realism*, our best theories, both past and present, are at least partly true because the assumptions which were essential in deriving their novel successful predictions are probably true (the riskier those predictions, the most probably true those assumptions).[5] Thus, it might be suggested that by checking which hypotheses were essentially

[5]Alai (2014a, §3.2); Alai (2014b, §4); Alai (2021).

deployed in novel predictions we should be able to discriminate what is true and what is false in our theories, so getting rid of the latter.

This, however, is clearly impossible, because otherwise we could anticipate future scientific progress, getting rid of our false assumptions, with no need to wait for future scientists to identify and reject them. Also, our negative heuristics would become much easier than they are, since, in the face of any experimental failure of a theory, we would know right away precisely which (ones) of its claims should be modified or abandoned. On the contrary, throughout the history of science mistakes have been eliminated only in hindsight, and scientists today, while trusting that current theories are largely true, grant that some of their assumptions are probably wrong, but only future research will tell which ones.

Distinguishing exactly and securely between true and false contents by checking which claims were deployed in novel predictions is impossible for at least two reasons: first, essential deployment in a novel prediction is reliable evidence that a hypothesis is true, but it is not a necessary condition for being true: various hypotheses in our theories may well be true even if they haven't passed such an acid test (or not yet). Second, not all the hypotheses actually deployed in a novel prediction were essential to it. For instance, suppose I hold the hypothesis that

H: *John has become terminally ill because of a voodoo rite performed by a shaman.*

From this I infer the prediction that

NP: *John will die*,

and unfortunately, he actually dies. However, to predict NP I did not need to assume H: only the weaker hypothesis that

H*: *John is terminally ill*

was essential to this prediction. Therefore, the truth of NP is not evidence for the truth of H, but at most of H*. In general, whenever a hypothesis H entails a prediction NP, there may be a weaker hypothesis H*, entailed by H, which also entails NP. In such case H is not essential to derive NP, and the prediction is not evidence of its truth.

Unfortunately, unlike in this trivial example, in most real-life scientific cases it is very difficult to tell whether a particular hypothesis H was essential in deriving a novel prediction or not. From a purely logical point of view, one could always ask whether there is any H* entailed by H and entailing NP. But first, often H may seem such a natural reason to predict NP, that one just doesn't feel the need to look for a weaker reason H*. Certainly, one doesn't even dream of checking *all* of the possible implications of H, in

order to see whether there are some which would also entail NP. Second, even if scientists realized that there is some weaker H* *logically* sufficient to derive NP, they might believe that still H is *physically* required, because of certain presuppositions explicitly or implicitly held by them. Here are a few examples.

(1) Fresnel and Maxwell derived various novel predictions from the hypothesis that

AV: ether vibrates.[6]

Today we know that AV is false, for ether does not exist. However, we have also understood that AV was inessential in those derivations, because it can be substituted by its weaker consequence

VM: there exist a vibrating *medium* (which today we call 'electromagnetic field').

Fresnel and Maxwell did not realize that AV was not essential, therefore possibly not true, probably because they presupposed that

PR1: all mediums are material,

and/or that

PR2: all vibrations are produced by the oscillations of particles.

Hence, given their presuppositions, *any* vibrating medium couldn't be but a *material medium composed of particles* (i.e., either water, or air, or *ether*). In this perspective, therefore, VM counted as physically equivalent to AV, hence AV appeared to be essential.

(2) Laplace predicted the speed of sound in air starting from a hypothesis we now know to be false:

H: the propagation of sound is an adiabatic process, in which some quantity of caloric contained by air is released by compression.

Now we know that H was not essential to Laplace's prediction, which could also be derived from the weaker hypothesis

H*: the propagation of sound is an adiabatic process, in which some quantity of latent heat contained by air (whatever be the nature of heat) is released by compression.[7]

[6] Lyons (2002, p. 72); Doppelt (2011, pp. 304, 306); (2013, §2); (2015, p. 275).
[7] See Psillos (1999, pp. 119–121).

However, at that time they presupposed that

PR3: gases can be heated without exchanges with the environment only if they contain heat in a latent form,

and

PR4: only material substances can be contained by material substances in a latent form.

But the material substance of heat was just caloric, hence it seemed that adiabatic heating could only be explained as the disengagement of caloric from ordinary matter, caused by mechanical compression.[8] In other words, given PR3 and PR4, H* entailed H, hence H seemed essential.

(3) Bohr predicted the spectral lines of ionized helium by assuming that

H: the electron orbits the nucleus only on certain specific orbital trajectories, each characterized by a given quantized energy.

H turns out to be false, but the same prediction could have been derived by the weaker hypothesis that

H*: the electron can only have certain, specific, quantized energy states.

But at that time it was natural to suppose that

PR5: quantized energies are the result of orbital trajectories,[9]

therefore, H was thought to be essential.

The same may happen with current theories: although a novel prediction NP was derived from a hypothesis H, H may entail a weaker hypothesis H* from which NP could also have been derived; however, given certain presuppositions PRS implicitly or explicitly accepted today, H may "appear to be conceptually or metaphysically entailed by" H*,[10] hence essential to NP, hence probably true. If, however, in the future those presuppositions were discovered to be false, we would learn that H was not essential, after all, therefore we could no longer be practically certain of its truth.

In fact, the revision of our beliefs may also follow the reverse order: suppose we fail to experimentally confirm H, or we find some prima facie experimental disconfirmation, or we notice that it is contradicts other accepted hypotheses: then, we may begin to doubt that H is true. However, if H is false, it cannot have been essential in predicting NP, because the

[8] Chang (2003, p. 904).
[9] Stanford (2006, p. 171).
[10] Vickers (2016, §4).

hypotheses essentially deployed in novel predictions are most probably true. In this case, therefore, we may question the presuppositions which make H seem essential, and perhaps eventually reject them.[11]

Of course, we cannot tell which of the presuppositions we hold today will be rejected in the future, hence whether any hypothesis we now consider as essential to a novel prediction, hence probably true, is actually so or not. In due course, *some* hypotheses will be discovered, retrospectively, to be inessential, but of no hypothesis at any time will we be certain that it was essential to some novel prediction. That is, even if we drop a hypothesis H which we no longer believe to be essential to a novel prediction NP and keep in its place a weaker hypothesis H* which still entails NP, we cannot ever be certain whether H* is essential, or it can be dispensed with in favor of a still weaker hypothesis H** entailed by H*.

In some cases we might be able to distinguish between the assumptions that from a purely logical viewpoint are strictly necessary to derive NP, and those that they entail in the light of our factual presuppositions, hence distinguish between our reason for believing H* (i.e., its essential role in predicting NP), and our reasons for believing the content of H exceeding H*, thus realizing that H were not as secure as H*. For instance, perhaps Bohr might have distinguished the extra-content of H from H*, so adopting a more guarded attitude toward the former.[12] In other cases, however, the presuppositions which make H indispensable may be too apparently obvious or deeply entrenched to be doubted or even noticed, as it happened with PR1, PR2, PR3, PR4, and PR5. Further such presuppositions may be the principles of conservation of energy and mass, isotropy and homogeneity of space, physical causal closure, etc. Perhaps we unconsciously presuppose many other very general principles, which may render essential certain hypotheses that are not such in a purely logical sense.

Therefore, the pessimistic meta-induction is probably right only in the sense that none of our theories is *completely* true (while it is wrong in claiming that they are *completely* false). On the other hand, Peters (2014),

[11]Even in this case, however, declaring that H was inessential would be independent of discovering that it was false (even if spurred by that discovery), because its inessentiality could be established only if independent reasons to reject those presuppositions were found. Therefore, the "no miracle" argument (NMA) can be defended from Lyons' (2002) "meta-modus tollens" without begging the question. In fact, Lyons claimed that the NMA is falsified by the fact that certain false hypotheses were (essentially) involved in successful predictions. The NMA can be rescued from this objection by claiming that it didn't commit us to the truth of those hypotheses because they were not essential. But if the only reason to claim that they were inessential was the discovery that they were false, that would be tantamount stipulating that the NMA is correct. However, this is not the case if those hypotheses are discovered to be inessential for independent reasons, as in the above examples (Alai 2021, p. 203).

[12]Vickers (2016, §4).

Votsis (2011) and Cordero (2017a, 2017b) are right that we can recognize whether a hypothesis H is true, but only in the sense that we can recognize whether it is *at least partly* true: if H was deployed in a novel prediction, either it was deployed essentially, hence it is completely true, or it was deployed inessentially, but then it is at least partly true, since it entails a weaker hypothesis H* that was actually essential to the prediction and is completely true. But we cannot be sure which one is the case, nor which the weaker hypothesis H* is.

Therefore, we are entitled to believe that there is *some* truth in current theories, and more precisely that there is some truth in some hypotheses which *appear* to have been essential to certain novel predictions; still, we cannot be certain of what exactly is true in them. However, the hypotheses deployed in novel predictions (or, at least, the parts of those hypotheses which are considered as essential) are typically preserved in successor theories; hence, science is cumulative, and we may trust that, *overall*, current theories are more largely true than past ones (and future ones will be even more largely true).

5 We cannot measure the percentage of truth in current theories

Nonetheless, since we are unable to circumscribe the strictly essential part of hypotheses, we cannot tell what in our theories is (almost) certainly true and what is not, hence what is the proportion of truth vs. falsity in them. A fortiori, we cannot tell how larger their proportion of truth is than that of past theories. Even less, of course, can we tell what proportion of the whole truth on its particular subject a theory contains, since we don't know what the whole truth is.

This uncertainty is also due to the fact that speaking of the "parts" of theories and hypotheses is vague and somewhat metaphorical. Since theories and hypotheses may be sorted out into parts in many equally legitimate ways, it is unclear what counts as a part, in particular as an elementary part, and it is even less clear how we should compare the "size" of different parts.

To take just a very simple example, suppose we follow the "statement view" and formalize a theory T as a collection of sentences: then we should count the atomic sentences entailed by T. This is a problem, however, since they are in principle numberless. Further, even apart from that, things can be quite undetermined: e.g., suppose that 95% of the empirical atomic sentences entailed by a theory T are true, but only 50% of its middle-level theoretical atomic sentences are true and only 10% of its most basic atomic theoretical sentences are true. If so, it might be a matter of taste whether to call T *largely* true or *largely* false, but it would certainly be correct to call "a revolution" the substitution of T by a theory T' which preserved most of

the empirical and middle-level theoretical sentences of T while substituting 90% of its most basic theoretical sentences.

Now, nothing allows us to exclude that several of our best theories today are in a similar condition. This is another reason to suppose that our science, successful and largely true as it is, will undergo further revolutions in the future, as argued above.

6 Is this moderate position still a realist one?

It might be asked: does this mean that all we know about current theories is that there is some truth somewhere in them? Isn't this too little and too pessimistic? Is my moderate position still a realist one? Can one be a scientific realist without being definitely committed to the (complete) truth of any particular hypothesis? I answer "no", "no", and "yes" (in the order).

First, it doesn't follow from the above that the only judgment we can reach about our theories is that "there is some truth somewhere". Although I focused on the hypotheses about whose truth we can be practically certain, we can have a more nuanced and articulated judgment on theories as a whole. As we know, (1) some claims in our theories are admittedly strictly speaking false, since they are idealizations or acknowledged simplifications. (2) Other hypotheses are considered by scientists as purely speculative, since they have no experimental confirmation (yet), nor any compelling theoretical support. They count just as interesting, suggestive, perhaps somewhat plausible, suggestions. (3) Still other hypotheses, instead, are (more or less) probable, since they have some empirical support, either inductive or deductive (e.g., by successful experimental control). Of course, the distinction between claims of type (2) and (3) is not neat, but gradual. Finally, (4) there are the hypotheses I have discussed so far, about which we can be practically certain that they are at least partly true, due to their role in novel risky predictions. For all we know, each of the hypotheses of kinds (2) and (3) might turn out to be completely false and be rejected in the future (although our subjective probability we attribute to their falsity can be very different for each hypothesis). Instead, those of kind (4) can be excluded to be completely false.

Second, deployment realists argue that when a theory has licensed risky novel predictions,

(I) we are *justified* in taking the theoretical claims deployed in those predictions as *true* (i.e., completely true if they are deployed essentially, and *partly* true if they are deployed inessentially),

and

(II) those claims are mostly preserved in successor theories;

therefore,

(III) we have cumulative *knowledge* of some unobservable structures of nature.

Thus, deployment realists provide a *general* criterion of realist commitment (I) and advance two *general* realist claims (II) and III): this is realism enough. On the other hand, *qua* philosophers and qua *realist*, they are not required to also *apply* criterion (I) to actual research. In fact, this would involve answering questions such as (i) Has hypothesis H been deployed in a prediction? (ii) Was that prediction actually novel? (iii) How risky was it? (iv) Was H essential to NP? Perhaps question (i) may be answered even by philosophers, but (ii) and (iii) require specific expertise in the field, they must be answered by historians of science for past theories, and by practicing scientists for current ones. In turn, (iv) is very hard to answer even for scientists, as explained above, and certainly out of reach for philosophers.[13] For this reason, even which hypotheses of current theories will be preserved in future theories and pile up in the growing accumulation of scientific knowledge cannot be securely told by scientists, let alone by philosophers.

Therefore, realists need not be personally committed to any particular theory or hypothesis, not even to the best current ones: that is not their task, they are just not equipped for it. *A fortiori*, it is paradoxical to ask (as Fahrbach 2017) that they teach scientists their own trade, telling them which are the working hypotheses and which are the idle parts in their theories, urging changes or suggesting directions of research.

According to Stanford (2017), realists believe in the truth of current theories, hence they are more conservative than anti-realists. But this is not the case for those who hold the moderate intermediate view I suggest: on the one hand, in fact, they only hold that current theories are more largely true than past ones, not that they are completely true. On the other hand, *qua* realists, they require hypotheses to satisfy a higher standard than anti-realists: truth, rather than just empirical adequacy or the like. Therefore, from their viewpoint it is even more likely that any particular hypothesis fails to reach that standard, hence that it must be substituted by a better one. Moderate realists are, if any, more progressivist than antirealists.

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[13] See Smart (1963, p. 36).

References

Alai, M. (2014a). "Novel Predictions and the No Miracle Argument", *Erkenntnis* 79(2), pp. 297–326.

Alai, M. (2014b). "Defending Deployment Realism against Alleged Counterexamples", in G. Bonino, G. Jesson, J. Cumpa (eds.), *Defending Realism. Ontological and Epistemological Investigations*, De Gruyter, Boston – Berlin – Munich.

Alai, M. (2017). "Resisting the Historical Objections to Realism: Is Doppelt's a Viable Solution?" *Synthese* 194(9), Special Issue: *New Thinking about Scientific Realism* (ed. E. Ruttkamp Bloem), pp. 3267–3290.

Alai, M. (2018). "How Deployment Realism Withstands Doppelt's Criticisms", *Spontaneous Generations: A Journal for the History and Philosophy of Science* 9(1), pp. 122–135.

Alai, M. (2021). "The Historical Challenge to Realism and Essential Deployment", in T. D. Lyons and P. Vickers (eds.), *Contemporary Scientific Realism. The Challenge from the History of Science*, Oxford University Press, New York 2021, pp. 183–215.

Chang, H. (2003). "Preservative Realism and Its Discontents: Revisiting Caloric", *Philosophy of Science* 70, pp. 902–912.

Cordero, A. (2017a). *Retention, truth-content and selective realism*, in E. Agazzi (ed.), *Varieties of Scientific Realism*, Cham, Springer, pp. 245–256.

Cordero, A. (2017b). "Making Content Selective Realism the Best Realist Game in Town", *Quo Vadis Selective Scientific Realism?* Conference, Durham, UK 5–7 August 2017.

Doppelt, G. (2005). "Empirical success or explanatory success: What does current scientific realism need to explain?" *Philosophy of Science* 72, pp. 1076–1087.

Doppelt, G. (2007). "Reconstructing scientific realism to rebut the pessimistic meta-induction", *Philosophy of Science* 74, pp. 96–118.

Doppelt, G. (2011). "From standard scientific realism and structural realism to best current theory realism", *Journal for General Philosophy of Science* 42, pp. 295–316.

Doppelt, G. (2013). "Explaining the success of science: Kuhn and scientific realists", *Topoi* 32, pp. 43–51.

Doppelt, G. (2014). "Best theory scientific realism", *European Journal for Philosophy of Science* 4, pp. 271–291.

Fahrbach, L. (2011). "Theory change and degrees of success", *Philosophy of Science* 78, pp. 1283–1292.

Fahrbach, L. (2017). "How Philosophy Could Save Science", *Quo Vadis Selective Scientific Realism?* Conference, Durham, UK 5–7 August 2017.

Lightman, A. P. (2005). *The discoveries: great breakthroughs in twentieth-century science, including the original papers*, Alfred A. Knopf, Toronto.

Lyons, T. D. (2002). "The Pessimistic Meta-modus Tollens", in S. Clarke and T. D. Lyons (eds.), *Recent themes in the philosophy of science. Scientific realism and commonsense*, Kluwer, Dordrecht, pp. 63–90.

Nickles, T. (2017). "Cognitive Illusions and Nonrealism: Objections and Replies", in: E. Agazzi (ed.), *Varieties of Scientific Realism: Objectivity and Truth in Science*, Springer, Cham, pp. 151–163.

Park, S. (2017a). "Justifying the Special Theory of Relativity with Unconceived Methods", *Axiomathes* 28, pp. 53–62.

Park, S. (2017b). "On Treating Past and Present Scientific Theories Differently", *Kriterion. Journal of Philosophy* 31(1), pp. 63–76.

Park, S. (2018). "The Pessimistic Induction and the Golden Rule", *Problemos* 93, pp. 70–80.

Peters, D. (2014). "What Elements of Successful Scientific Theories are the Correct Targets for "Selective" Scientific Realism?" *Philosophy of Science* 81, pp. 377–397.

Psillos, S. (1999). *Scientific realism. How science tracks truth*, Routledge, London.

Smart, J. J. C. (1963). *Philosophy and Scientific Realism*, Routledge, London.

Stanford, P. K. (2006). *Exceeding our grasp: Science, history, and the problem of unconceived alternatives*, Oxford University Press, Oxford.

Stanford, P. K. (2017). "A Difference That Makes a Difference: Stein on Realism, Instrumentalism, and Intellectually Nourishing Snacks", *Quo Vadis Selective Scientific Realism?* Conference, Durham, UK 5–7 August 2017.

Vickers, P. (2016). "Understanding the Selective Realist Defense Against the PMI", *Synthese* 194, pp. 3221–3232.

Votsis, I. (2011). "The Prospective Stance in Realism", *Philosophy of Science* 78, pp. 1223–1234.

Wray, B. (2016). "Method and Continuity in Science", *Journal for General Philosophy of Science* 47(2), pp. 363–375.

Quine's naturalism: clarification and vindication

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Abstract. Naturalism is the dominant characteristic of Quine's philosophy. This paper presents a more comprehensive and sympathetic clarification of Quine's naturalized epistemology (NE for short), and vindicates its main positions by critically responding to three objections: replacement (that Quine's NE replaces of traditional epistemology), circularity (that Quine's NE is viciously circular), and non-normativity (that Quine's NE lacks normative dimension). It also addresses Williamson's three critics against naturalism (primarily Quine's version). The paper concludes that both the objections and Williamson's critics largely stem from misreading or misinterpretation. It argues that Quine's NE still contains illuminating, reasonable, and valuable insights worthy of further development.

As many Quine scholars agree[1], naturalism is the dominant characteristic of Quine's philosophy. In 1968, Quine delivered a public lecture titled "Epistemology Naturalized" in Vienna. After that, a so-called "naturalistic turn" or "naturalistic revolution"[2] gradually took place in contemporary analytic philosophy. There have also been many objections to Quine's views and arguments. For example, Wrenn mentions two: the problems of circularity and normativity;[3] Rysiew mentions five: being *non sequitur*; being viciously circular; unsatisfactory response to skepticism; stripping away any concern with epistemic normativity; and being self-defeating.[4] Bergström defends Quine's naturalism against most of these objections, and others, in his own way.[5] Maddy traces three earlier versions of naturalism—in Reichenbach, Quine and Arthur Fine—responds to some well-known

[1]See Roger F. Gibson, Jr., *The Philosophy of W. V. Quine* (Tampa, FL: University of South Florida Press, 1982); *Enlightened empiricism: An Examination of W. V. Quine's Theory of Knowledge* (Tampa, FL: University of South Florida Press, 1988); Gary Kemp, *Quine: A guide for the perplexed* (New York: Continuum, 2006); "Quine: The Challenge of Naturalism", *European Journal of Philosophy* 18 (2010): 283–295; Peter Hylton, *Quine* (London and New York: Routledge, 2007); Paul A. Gregory, *Quine's Naturalism: Language, Knowledge and the Subject* (New York: Continuum Press, 2008); Sander Verhaegh, *Working from Within: The Nature and Development of Quine's Naturalism* (New York: Oxford University Press, 2018).

[2]Verhaegh, *Working from Within*, 4.

[3]Chase B. Wrenn, "Naturalistic Epistemology", *Internet Encyclopedia of Philosophy*, (2003).

[4]Patrick Rysiew, "Naturalism in Epistemology", *The Stanford Encyclopedia of Philosophy* (Fall 2016).

[5]Lennart Bergström, "Defense of Quinean Naturalism", in *Naturalism, Reference, and Ontology: Essays in Honor of Roger F. Gibson*, ed. Chase B. Wrenn (New York: Peter Lang, 2008), 25–46.

The Relevance of Judgment for Philosophy of Science, edited by Jure Zovko.
Comptes Rendus de l'Académie Internationale de Philosophie des Sciences 4 (2025).
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objections (mainly Putnam's) to various loosely naturalist projects, and clarifies her improved version of naturalism.[6] In this paper, I aim to present a more comprehensive and sympathetic clarification of Quine's naturalized epistemology (hereafter NE), and to vindicate his main arguments within the framework of his philosophy by responding to three major objections to NE: replacement, circularity and non-normativity, as well as to Williamson's three critics of naturalism (mainly Quine's version).

1 Concise account of Quine's naturalism

Firstly, I will clarify Quine's characterization of his naturalism.

Although naturalism has a long, rich, and complicate history in philosophy, Quine's advocacy of it is among the most influential in contemporary philosophy. Typically, two kinds of naturalism are distinguished. Metaphysical naturalism asserts that only natural entities and phenomena revealed by our sciences exist—there are no non-or-super-natural ones like gods, ghosts or non-embodied mind in the world. Methodological naturalism claims that in our pursuit of knowledge about nature, we must rely on the achievements, standards, and methodology provided by sciences, and that there is no other kind of reliable methodology, especially not any special philosophical ones. Verhaegh identifies a third kind of naturalism in Quine's NE, namely metaphilosophical naturalism, to the extent that there is no sharp distinction between science and philosophy, since we must work within a growing system into which we are born, and there is no transcendental, distinctively philosophical perspective from which to question this system.[7]

In his John Dewey Lectures, "Ontological Relativity" (1968), Quine first used the term "naturalism", borrowed from Dewey, to describe his philosophical position.[8] However, naturalism runs through his earlier writings—beginning before "Tow Dogmas of Empiricism" (1951)—and continues in his later works such as *Pursuit of Truth* (1990) and *From stimulus to Science* (1995).[9] It is also implicit in many of his well-known theses, including indeterminacy of translation, inscrutability of reference, ontological relativity, underdetermination of theory by evidence, moderate holism, and rejection of analytic-synthetic and a priori-a posteriori distinctions. According to Gibson, in Quine's philosophy

[6]Penelope Maddy, "Naturalism: Friends and Foes", in *Philosophical Perspectives* 15 (2001): 37–67.

[7]Sander Verhaegh, "Setting Sail: The Development and Reception of Quine's Naturalism", *Philosophers' Imprint* 18(19) (2018).

[8]W. V. Quine, *Ontological Relativity and Other Essays* (New York: Columbia University Press, 1969), 26.

[9]W. V. Quine, "Two Dogmas of Empiricism", *Philosophical Review* 60(1) (1951): 20–43; *Pursuit of Truth* (Cambridge, MA: Harvard University Press, 1992); *From Stimulus to Science* (Cambridge, MA: Harvard University Press, 1995).

> [n]aturalism consists of a pair of theses, one negative, one positive. The negative thesis is that *there is no successful first philosophy*, that is, there is neither an a priori nor an experiential foundation outside of science upon which science can be grounded (i.e. justified or rationally reconstructed). The positive thesis is that *science is the measure both of what there is (ontology) and how we know what there is (epistemology)*.[10]

Quine's naturalism is primarily of the metaphilosophical variety identified by Verhaegh (2018), within which the metaphysical and methodological kinds are also included.[11] I agree with Maddy: "Naturalism, as I understand it, is not a doctrine, but an approach; not a set of answers, but a way of addressing questions. As such, it can hardly be described in a list of theses: it can only be seen in action."[12] I prefer to let Quine speak himself in chronological order:

> [...] my position is a naturalistic one; I see philosophy not as an a priori propaedeutic or groundwork for science, but as continuous with science. I see philosophy and science as in the same boat—a boat which, to revert to Neurath's figure as I so often do, we can rebuild only at sea while staying afloat in it. There is no external vantage point, no first philosophy.[13]

> [...] naturalism: abandonment of the goal of a first philosophy. It sees natural science as an inquiry into reality, fallible and corrigible but not answerable to any supra-scientific tribunal, and not in need of any justification beyond observation and the hypothetico-deductive method.[14]

> [...] naturalism: the recognition that it is within science itself, and not in some prior philosophy, that reality is to be identified and described.[15]

In his foreword to Gibson (1988), Føllesdal clarifies Quine's naturalism in a pertinent and illuminating way:

> This core is Quine's naturalism: philosophy is natural science trained upon itself; there is no first philosophy, no external vantage point. In particular, this holds for epistemology: epistemology is contained

[10]Roger F. Gibson, Jr., "Quine's Philosophy: A Brief Sketch", in *The Philosophy of W. V. Quine*, eds. Hahn, Lewis Edwin, and Paul Arthur Schilpp (IL: Open Court; second, expanded edition, 1998), 668.

[11]See Verhaegh, "Setting Sail: The Development and Reception of Quine's Naturalism", 1–24.

[12]Maddy, "Naturalism: Friends and Foes", 37.

[13]W. V. Quine, *Ontological Relativity and Other Essays*, 126–127.

[14]W. V. Quine, *Theories and Things* (Cambridge, MA: Harvard University Press, 1981), 72.

[15]Ibid., 21.

> in natural science, as a chapter of empirical psychology, and yet it is epistemology that provides an account of the evidential bases of natural science, including empirical psychology itself. As Gibson expresses it (using "ontology" for "natural science"): epistemology and ontology contain one another.[16]

Secondly, I will clarify Quine's project of naturalized epistemology.

At the beginning of his *Pursuit of Truth* (1990), Quine states the central question of his NE:

> From impacts on our sensory surfaces, we in our collective and cumulative creativity down the generations have projected our systematic theory of the external world. Our system is proving successful in predicting subsequent sensory input. How have we done it?[17]

In his writings, this question is formulated in different ways: How do we start from "the meagre input", namely, our sensory stimulation from the world, to reach "the torrential output", namely, our overall scientific theories of the external world? Or, how do our overall theories of the world originate from our observation of the world? Quine holds that any meaningful conceptualization is inseparable from language, and that various theories, including our sciences of nature, can be regarded as systems of sentences:

> A theory, it will be said, is a set of fully interpreted sentences. (More particularly, it is a deductively closed set: it includes all its own logical consequences, insofar as they are couched in the same notation.)[18]
>
> [...] I characterized science as a linguistic structure that is keyed to observation here and there.[19]

Thus, the central question of NE becomes the question of accounting for the relationship between observation and our theoretical discourses. This question is divided into two sub-questions: one is how our sensory evidence supports our global theories of the world, referred to as the "evidential support question"; the other is how our scientific theories grow out of our sensory evidence, referred to as the "causal question."

However, the concept of observation poses some difficulties. Since observation occurs at the sensory level, it is subjective; but in the context of language learning and evidence evaluation, observation is required to be socially shared. Moreover, if we take observation not as sensation or perception but as publicly shared environmental situations, we gain nothing, since we cannot assume intersubjective agreement about environmental

[16]Gibson, *Enlightened empiricism*, ix.
[17]W. V. Quine, *Pursuit of Truth*, 1.
[18]W. V. Quine, *Ontological Relativity and Other Essays*, 51.
[19]W. V. Quine, *Quintessence – Basic Readings from the Philosophy of W. V. Quine*, ed. Roger F. Gibson, Jr. (Cambridge, MA: Harvard University Press, 2004), 298.

situations—different subjects may notice different aspects of the same situation. To overcome these difficulties, Quine proposes to talk about observation sentences rather than observation: "No matter that sensations are private, and no matter that men may take radically different views of the environing situation; the observation sentence serves nicely to pick out what witnesses can agree on."[20]

By replacing observation with observation sentences, the central question of NE becomes the question of explaining the relationship between our observation sentences and theoretical sentences. This relationship also has two aspects: one is epistemological—how can one sentence provide evidence for another?—answered by the theory of scientific evidence; the other is semantic—where and how do sentences get their meaning?—answered by the theory of language learning. Quine asserts that there is a close connection between the two: "The channels by which, having learned observation sentences, we acquire theoretical language, are the very channels by which observation lends evidence to scientific theory."[21] Føllesdal rightly asserts, "This is a key point in Quine: Semantics and epistemology are intimately intertwined."[22]

Therefore, NE has two empirical tasks: first, it provides detailed causal explanations for the learning mechanism from sensory input to observation sentences; second, it gives a detailed explanation of the various analogical steps from observation sentences to theoretical language acquisition. Observation sentences typically exhibit the intersubjective observability of the relevant situation in which they are uttered, and play an important role in both epistemological and semantic relations. It is observation sentences that become the entering wedge both to language and to science; and it is language that becomes the entering wedge to Quine's NE:

> We see, then, a strategy for investigating the relation of evidential support, between observation and scientific theory. We can adopt a genetic approach, studying how theoretical language is learned. For the evidential relation is virtually enacted, it would seem, in the learning. This genetic strategy is attractive because the learning of language goes on in the world and is open to scientific study. It is a strategy for the scientific study of scientific method and evidence. We have here a good reason to regard the theory of language as vital to the theory of knowledge.[23]

Quine further argues that the process and mechanism by which humans learn a theoretical language is the same as the process and mechanism by

[20]W. V. Quine, *Roots of Reference*, (La Salle, Ill.: Open Court, 1974), 39.
[21]W. V. Quine, *Quintessence*, 294.
[22]Dagfinn Føllesdal, "Preface of the New Edition of *Word and Object*", in W. V. Quine, *Word and Object* (Cambridge, Mass.: The MIT Press, 2013), xviii.
[23]Quine, *Quintessence*, 294.

which they master a scientific theory: "The paths of language learning, which lead from observation sentences to theoretical sentences, are the only connection there is between observation and theory."[24] Therefore, "to account for man's mastery of scientific theory we should see how he acquires theoretical language."[25] Thus, Føllesdal asserts that the epistemology of evidential support and the semantics of language learning and meaning acquisition are combined in Quine's NE.[26]

In this way, for Quine, epistemology is naturalized to a considerable extent: it is reduced to the empirical research of the actual process and mechanism of language learning—how does a child, based on the stimulation of his sensory receptors by the world, learn theoretical (or referential, or cognitive) language with which he will be able to refer to objects? Epistemology has thereby become a chapter of empirical psychology, and then a book of natural science, and the genetic approach has become the most important method of NE.

2 Unfolding Quine's naturalized epistemology

In this section, I will outline what Quine has done in his NE in order to provide the foundation for further agreement or disagreement.

2.1 Taking for granted: external objects, public language

Inspired by Føllesdal (2011, 2013), I will focus on what Quine takes for granted in his NE, as these assumptions are crucial to a correct understanding of his NE and, more broadly, of his philosophy.

First, Quine maintains that distal objects, rather than proximal stimulation, are what we must confront in language learning and cognition. In other words, before we begin to perceive and recognize this world, external objects are already there, serving as the sources of our perception and recognition. In the beginning of his *Word and Object* (1960), Quine writes,

> Physical things generally, however remote, become known to us only through the effects which they help to induce at our sensory surfaces. [...] Linguistically, and hence conceptually, the things in sharpest focus are the things that are public enough to be talked of publicly, common and conspicuous enough to be talked of often, and near enough to sense to be quickly identified and learned by name; it is to these that words apply first and foremost.[27]

In his 2000 paper, Quine introduces an epistemological triangle consisting of I (the cognizer), you (other people), and it (an object, e.g. an aardvark)

[24] Ibid., 298.
[25] Quine, *Roots of Reference*, 37.
[26] See Dagfinn Føllesdal, "Developments in Quine's Behaviorism", *American Philosophical Quarterly* 48(3) (2011): 273–282.
[27] Quine, *Word and Object*, 1.

as three vertices. Since I and you differ greatly in neural constitution and internal mechanisms of perception, "We thus differ in the proximal causes of our concordant use of the word, but we share the distal cause, the reference, farther out on our causal chains"[28]. Føllesdal[29] reports that Quine wished to develop and expand upon the key idea of this paper in the new edition of *Word and Object* (2013).

Second, Føllesdal notes that "Quine was the first to take the social nature of language seriously and explore its consequences for meaning and communication."[30] In the preface of *Word and Object*, Quine writes,

> Language is a social art. In acquiring it we have to depend entirely on intersubjectively available cues as to what to say and when. Hence there is no justification for collating linguistic meanings, unless in terms of men's dispositions to respond overtly to socially observable stimulations.[31]

For Quine, language is a social and publicly observable activity among speakers, and "meaning" is a characteristic of verbal behavior. It must therefore be clarified in behaviorist terms and can only be acquired through the overt behaviors of interlocutors. When a child learns her native language, or an adult learns a foreign one, she must rely on "the evidence solely of other people's overt behavior under publicly recognizable circumstances."[32]

Third, in my view, the following passage is also crucial to correct understanding of Quine's influential and controversial theses, for example, the indeterminacy of translation, the underdetermination of theory by data, and holism:

> We cannot strip away the conceptual trappings sentence by sentence and leave a description of the objective world; but we can investigate the world, and man as a part of it, and thus find out what cues he could have of what goes on around him. *Subtracting his cues from his world view, we get man's net contribution as the difference. This difference marks the extent of man's conceptual sovereignty*—the domain within which he can revise theory while saving the data.[33]

In both language learning and theory construction, we are constrained by two kinds of elements: those imposed by the world and those arising from our own cognitive activity. There is a tension between them: "[...] we ought to be able to see just to what extent science is man's free creation; to

[28]W. V. Quine, "I, You, and It", in *Knowledge, Language and Logic*, eds. Alex Orenstein and Petr Kotatko (Dordrecht, Holland: Kluwer Academic Publishers, 2000), 1.

[29]Føllesdal, "Preface of the New Edition of Word and Object", xix–xx.

[30]Føllesdal, "Developments in Quine's Behaviorism", 274.

[31]Quine, *Word and Object*, ix.

[32]Quine, *Ontological Relativity and Other Essays*, 26.

[33]Quine, *Word and Object*, 4; my emphasis.

what extent, in Eddington's phrase, it is a put-up job"[34]. We are not wholly passive but retain a degree of freedom, a creational space, in the process of language acquisition and theory formation.

2.2 Stimulation: triggering of sensory receptors

To account for language learning and theory formation, Quine appeals to a series of behavioristic terms—such as shared circumstance, verbal behavior, disposition, pleasure, query, assent, dissent, reward, penalty—as well as to neuropsychological terms such as innateness, among others.

The starting point is stimulation. Since external objects cannot directly enter our processes of learning and cognition, we must begin with the stimulation (triggering) of our sensory receptors (eyes, ears, nose, tongue, and body) by those objects. An episode refers to the state in which we receive stimulation; both reception and perception are forms of received stimulation. In order to use similar expressions in similar situations, our perceptions must exhibit "perceptual similarity:" two episodes should count as perceptually similar if they affect a cognitive subject's behavior in the same way. For a subject, episode a is more perceptually similar to b than to c just in case the subject exhibits the same response to episodes sufficiently similar to a. To account for the fact that different subjects produce similar responses to similar episodes, Quine invokes the pre-established harmony of our standards of perceptual similarity. Perceptual similarity and pre-established harmony are explained by Darwinian natural selection: such standards are partly inherited from our ancestors' genes and have survival value in the world. As Quine writes:

> Perceptual similarity is the basis of all learning, all habit formation, all expectation by induction from past experience; for we are innately disposed to expect similar events to have sequels that are similar to each other.[35]

Stimulus meaning refers to the meaning of a sentence relative to a specific speaker A at a particular time t under a particular situation s. It can be formally defined as follows: the stimulus meaning of a sentence p for A at t and s is an ordered pair of two sets (Σ, Σ'), where Σ is the set of stimuli that causes A to assent to p at t and s, and Σ' is the set of stimuli that causes A dissent from p at t and s.

2.3 Entering language: classification of sentences

Based on stimulus meaning and degree of dependence on concurrent stimuli, Quine classifies sentences uttered or heard in publicly recognizable circumstances into two kinds: occasion sentences and standing sentences. An

[34] Quine, *Roots of Reference*, 3–4.
[35] Quine, *Quintessence*, 277.

occasion sentence elicits assent or dissent only if some prompting (usually nonverbal) stimulus is present. Occasion sentences are further divided into observational and non-observational ones. An observation sentence is an occasion sentence on which speakers of the language can agree outright upon witnessing the occasion—for example, "This is red." A standing sentence elicits assent or dissent each time it is presented, without further prompting by some (usually nonverbal) stimulus—for example, "Today is Friday." Standing sentences are further divided into eternal and non-eternal ones. An eternal sentence is a standing sentence that remains true or false for all time—for example, "Copper conducts electricity."

2.4 Ostensive learning and analogical syntheses

There are two general methods by which a child learns her native language: ostensive learning and analogical synthesis. The former proceeds roughly as follows: in the presence of an object, a mother points to or touches the object and utters some sentences as unstructured wholes—what Quine calls *holophrastically*—thereby teaching her child to associate those sentences with the object, until her child eventually knows how to use them in appropriate situations. This method approximates the psychological schematism of direct conditioning. Quine writes:

> Ostensive learning is fundamental, and requires observability. The child and the parent must both see red when the child learns 'red,' and one of them must also see that the other sees red at the time.[36]

Observation sentences thus form the first batch of sentences a child learns ostensively. However, ostensive learning cannot take the child very far, because most sentences in a natural language are not tied, even derivatively, to fixed ranges of nonverbal stimulation. Consequently, a child must learn the greater portion of her native language by means of analogical synthesis: having acquired some sentences and words, she can replace words in the learned sentences with others, thereby generating new expressions she has not been explicitly taught. For example, having learned 'black dog,' 'black cat' and 'white ball,' the child may say 'black ball' in the presence of a black ball. Similarly, having learned "My finger hurts", she may produce the new sentence "My foot hurts" without instruction. Analogical synthesis accounts for the creativity of language.

2.5 Observation sentences and observation categoricals

Observation sentences possess the following features: (i) they are directly about physical objects and are correlated with sensory stimulation, so they can be learned ostensively; (ii) they do not require collateral information—in order to assent to or dissent from an observation sentence such as "This

[36] Quine, *Roots of Reference*, 37–38.

is red", no further information from other sources is needed, and one can respond immediately in the relevant environment; (iii) they are intersubjective—every witness will give the same assent to or dissent from the same observation sentence; (iv) they are loaded with their empirical content even when considered in isolation. These features make observation sentences the entry point to language learning, the repository of evidence for scientific hypotheses, and the cornerstone of semantics.

An observation categorical is compounded of observation sentences and takes a general form such as "Whenever this, that", expressing something akin to a natural law. As Quine writes, an observation categorical is a "miniature scientific theory"[37]. Consider the following two examples:

(i) Whenever the sun comes up, the birds sing.

(ii) Whenever a willow grows at the water's edge, it leans over the water.

Here, (ii) is a *focal* observation categorical, in which both antecedent and consequent refer to the same object, whereas (i) is a *free* one. An observation categorical is tested by pairs of observations. It is never conclusively verified by conforming observations, but it can be refuted by a pair of observations, one affirmative and one negative. As Quine observes:

> Still the deduction and checking of observation categoricals is the essence, surely, of the experimental method, the hypothetico-deductive method, the method, in Popper's words, of conjecture and refutation. It brings out that prediction of observable events is the ultimate test of scientific theory.[38]

2.6 Referring to objects

For Quine, the central question of epistemology is how we proceed from stimulation to science. A theory of the world is largely a theory of what exists in the world, but what a theory says exists is a matter of reference. Thus, we must account for children's "acquisition of an apparatus for speaking of objects"[39]. In Quine's view, "To be is to be a value of variable"[40]; that is, quantificational constructions constitute the referential apparatus of a language or theory. To learn how to refer to objects, children must acquire "a cluster of interrelated grammatical particles and constructions: plural endings, pronouns, numerals, the 'is' of identity, and its adaptations 'same' and 'other'"[41], together with logical connectives, relational clauses,

[37] Quine, *From Stimulus to Science*, 26.
[38] Quine, *Quintessence*, 280.
[39] Quine, *Roots of Reference*, 81.
[40] W. V. Quine, *From A Logical Point of View* (Cambridge: Harvard University Press, 1953), 15.
[41] Quine, *Ontological Relativity and Other Essays*, 32.

predications, and so on. Moreover, to make the ontological commitments of a theory explicit (i.e., to determine what the theory says there is), we must translate it into the language of first-order logic (its 'canonical notation'). This procedure is called "semantic regimentation." Our scientific theory of the world is formulated in theoretical language; once we have learned this language, we can articulate our theory of the world and thus complete the journey from stimulus to science.

Quine advocates the acceptability criterion of ontological commitment: "No entity without identity"[42]. Here, identity means reification or individuation: if we cannot provide reliable criteria of identity for certain objects, we cannot rationally commit ourselves to their existence in our theory. According to Quine, only physical objects and classes or sets genuinely exist, since they can be afforded stable standards of identity. So-called "intentional entities"—such as meanings, propositions, attributes or properties, and relations—cannot be feasibly individuated; opaque contexts containing propositional attitudes and modalities fall outside the realm of extensionality. Hence, we should, in Quine's words, "take flight" from all such entities in our global theory of the world.

2.7 Some further consequences

From the foregoing account of Quine's NE, several important consequences follow:

(1) Indeterminacy of translation. "[...] manuals for translating one language into another can be set up in divergent ways, all compatible with the totality of speech dispositions, yet incompatible with one another."[43] More importantly, there is no fact of the matter to determine which translation manual is the uniquely correct. This thesis shows that "the notion of propositions as sentence meanings is untenable."[44]

(2) Inscrutability of reference (also called "indeterminacy of reference"). Suppose a linguist hears a native speaker say "gavagai" in the presence of a rabbit. The linguist cannot tell with certainty whether "gavagai" refers to a rabbit, an undetached rabbit part, a temporal stage of a rabbit, or rabbithood, because all these interpretations are compatible with the native speaker's verbal behavior, given appropriate compensatory adjustments elsewhere.

(3) Ontological relativity. The ontology of a theory—that is, the objects whose existence the theory commits us to—is relative to the background language and the translation manual it employs, as well as to the referential

[42] Quine, *Ontological Relativity and Other Essays*, 23.
[43] Quine, *Word and Object*, 27.
[44] Quine, *Pursuit of Truth*, 102.

interpretation of quantifiers. There is no clear-cut, absolute fact of the matter about a theory's ontology. Quine illustrates this primarily through the concept of a 'proxy function,' deducing the surprising conclusion that ontology is, in a sense, indifferent to our scientific theories of the world. This raises a question: is this conclusion compatible with Quine's robust realist commitments?

(4) Underdetermination of theory by evidence. Our theories of the world go beyond all possible observations of it, meaning it is possible to have empirically equivalent but logically incompatible world-systems. This suggests that "there are various defensible ways of conceiving the world"[45]. However, Quine later appears to soften this claim:

> On closer inspection, logical incompatibility on the part of empirically equivalent theory formulations is seen to be a red herring. We are thus left only with empirically equivalent theory formulations that are logically reconcilable. If we subscribe to one of them as true, we can call them all true and view them as different descriptions of one and the same world.[46]

(5) Holism, fallibilism, and rejection of apriority and analyticity. "our statements about the external world face the tribunal of sense experience not individually but only as a corporate body"[47]; each statement shares its empirical content with others in the corporate body. There are no a priori statements completely independent of experience, and no analytic statements with null empirical content. Any statement, including logical and mathematical ones, is in principle revisable in the face of recalcitrant experience. In revising our theories, we must follow the maxim of minimum mutilation, and so on.

I agree with Gibson's assertion that Quine's "philosophy is best understood as a systematic attempt to answer, from a uniquely empiricist point of view, what he regards as the central question of epistemology, namely, 'How do we acquire our theory of the world and why does it work so well?'"[48].

At this point, it is worth briefly consider a well-known objection to Quine's NE from Davidson (1986). According to Davidson, the connection between stimulations and observation sentences is causal and therefore cannot be justificatory, since "nothing can count as a reason for holding a belief

[45]Quine, *Pursuit of Truth*, 102.

[46]W. V. Quine, *Confessions of a Confirmed Extensionalist and Other Essays*, eds. Dagfinn Føllesdal and Douglas B. Quine (Cambridge: Harvard University Press, 2008), 321.

[47]Quine, *From A Logical Point of View*, 41.

[48]Gibson, *Enlightened Empiricism*, 1.

except another belief"[49]. On his view, causation cannot confer justification because epistemic justification must be propositional and logical. Thus, causal relations between beliefs and the experiences that prompt them play no justificatory role. Quine, Davidson claims, confuses causes with reasons, or simply ignores reasons altogether in his NE.

I disagree with Davidson for three reasons: (1) The causal link between stimulation and an observation sentence can indeed provide a reason to believe the truth of the sentence. Why can I not know that John was there because I saw him, or that she was Susan because I recognized her voice? (2) Beyond causal connections, Quine also accounts for the evidential links between observation sentences and theoretical sentences. (3) Because of his holism, Quine does not place great emphasis on the justification of knowledge. For theoretical purposes, he suggests that we abandon the notion of knowledge as a "bad job", since it "does not meet scientific and philosophical standards of coherence and precision"[50]. Thus, his NE is neither knowledge-centered nor justification-centered epistemology. (Further discussion will follow in next section.)

3 Reforming rather than replacing traditional epistemology

Regarding the relation of Quine's NE with traditional epistemology (TE), there are sharply opposed parties with conflicting viewpoints. One party holds that Quine's NE replaces TE, or worse, abandons epistemology altogether: "W. V. Quine is well known for urging the abandonment of epistemology, as traditionally pursued, in favor of the scientific project he calls 'naturalized epistemology'";[51] Quine advocates replacement naturalism—we should abandon epistemology in favor of psychology. "Quine seems to be recommending that we abandon the effort to show that we do in fact have knowledge and that we instead study the ways in which we form beliefs."[52] Another party maintains that Quine does not attempt to replace TE, but rather to reform it—that is, to approach the old questions of TE in a wholly new way: "On my reading, not only does Quine *not* urge abandonment of epistemology as traditionally pursued, *but*, whatever inspirational role 'Epistemology Naturalized' may have played toward 'naturalism in episte-

[49]Donald Davidson, "A Coherence Theory of Truth and Knowledge", in *Truth and Interpretation: Perspectives on the Philosophy of Donald Davidson*, ed. E. LePore (Oxford: Blackwell, 1986), 310.

[50]W. V. Quine, *Quiddities: An Intermittently Philosophical Dictionary* (Cambridge: Harvard University Press, 1989), 109.

[51]Ernest Sosa and Jaekwon Kim (eds.), *Epistemology: An Anthology* (Malden, MA: Blackwell, 2000), 289.

[52]Richard Feldman, "Naturalized Epistemology", *The Stanford Encyclopedia of Philosophy* (Summer 2012).

mology,' its central proposal is actually antithetical to a good deal of what is nowadays done that heading."[53] Haack takes a middle position, arguing that Quine's naturalism has two faces: one modest and reformist, the other scientistic and revolutionary, and thus has a sort of ambivalence. She claims: "Quine offers a sort of composite of three, mutually incompatible, styles of naturalism, of the aposteriorist and the scientistic, the reformist and the revolutionary."[54] In this section, I will address these controversies and argue that Quine's NE is not a replacement but a reformation of TE.

Firstly, I will carefully examine Quine's criticism of TE.

TE seeks a firmer foundation of science than that provided by science itself. It is a kind of transcendental research: it attempts to account for the reliability of science by transcending science. Quine calls this kind of TE "first philosophy", which includes modern rationalism and empiricism, and he criticizes both radically.

Descartes is the founder of modern rationalism. He pursues absolutely certain knowledge about the world and about ourselves. Appealing to the method of universal doubt, he tries to eliminate all doubtful elements from our knowledge and to lay down an unshakable foundation for it. He takes obvious, clear, distinct, and rational axioms like "I think, therefore I am" as the foundation of knowledge, from which he deduces all other parts of our global theory of the world. Quine does not pay much attention to Descartes' project, since even in the field of mathematics it is impossible to accomplish complete deduction of the unobvious principles from the obvious ones—due to Gödel's incompleteness theorem and the failure to reduce mathematics to first-order logic.

Quine turns his attention instead to empiricism, with which he is most sympathetic. Empiricism has a continuous development from Locke, Berkeley and Hume to Russell and Carnap, and takes sensory experience or observation propositions as the solid foundation of human cognition. Its main creed is that all our knowledge originates from sensory experience. Quine calls it "radical empiricism" and argues that it has two main tasks: one is to deduce truths about the world from sensory evidence; the other is to translate (or define) these truths by means of sensory or observational terms plus logico-mathematical auxiliaries. By analogy with study of the foundation of mathematics, he calls the former as the doctrinal side of empiricism, which focuses on using sensory evidence to justify our knowledge of the world; and the latter the conceptual side, which focuses on using sensory vocabulary

[53]Bredo C. Johnsen, "How to Read 'Epistemology Naturalized'", *The Journal of Philosophy* 102(2) (2005): 79; my emphasis.

[54]Susan Haack, "The Two Faces of Quine's Naturalism", *Synthese* 94 (1993): 335; *Evidence and Inquiry: A Pragmatist Reconstruction of Epistemology* (New York: Prometheus, 2009), 180.

to explain or define the concept of body (namely physical objects). Quine argues that both sides of empiricism have suffered disastrous failure.

First, consider the doctrinal side. According to Hume, statements directly concerning current sensory impressions are quite certain. However, general statements about existence and about the future cannot attain any degree of certainty, since even the weakest generalizations of observable objects—such as "Birds fly" or "Grass is green"—involve the logical leap from observed to unobserved items, and from past and present experience to future predictions. Thus, the attempt to logically validate our theory of the world using direct sensory experience cannot succeed. Quine emphasizes: "The Humean predicament is the human predicament."[55]

Next, consider the conceptual side. It appears to have made some real progresses—for example, the shift from Locke's ideas to Tooke's words, the semantic focus shift from terms to sentences (Bentham), and from sentences to systems of sentences (Duhem, Neurath and Quine himself). People can also talk about objects through contextual definitions and set theory. Russell uses this method to study the epistemology of natural knowledge and seeks to interpret external world as the logical construction of sense data. Carnap's *The Logical Structure of the World* (1928) represents the most serious implementation of this program. He acknowledges that it is impossible to deduce science from direct experience, but still maintains that scientific concepts can be defined using observation terms plus logico-mathematical auxiliaries. He devotes himself to the rational reconstruction of scientific discourse, but ultimately fails. Quine explains why Carnap's attempt fails: "[...] the typical statement about bodies has no fund of experiential implications it can call its own. A substantial mass of theory, taken together, will commonly have experiential implications; this is how we make verifiable predictions."[56]

Therefore, the entire project of TE,—whether rationalist or empiricist—must be rejected. It is impossible to deduce the truth of scientific theory from rational axioms, sensory experience, or observational propositions, or to define scientific vocabulary by sensory and observational terms plus logico-mathematical auxiliaries. Moreover, the ideal of searching for absolutely certain knowledge must be abandoned: "The Cartesian quest for certainty had been the remote motivation of epistemology, both on its conceptual and its doctrinal side; but that quest was seen as a lost cause",[57] because, according to Quine's holism, no statement is absolutely certain; any statement is revisable in the face of hard counterexamples. Quine notes that when, following Dewey, we adopt a naturalistic view of language and a

[55]Quine, *Ontological Relativity and Other Essays*, 72.
[56]Ibid., 79.
[57]Ibid., 74.

behavioral conception of meaning, we must give up not only the museum image of language but also the assurance of determinacy concerning meaning, reference, and knowledge. We must recognize that there are no similarity or differences of meaning beyond those being implicit in people's verbal dispositions.

Secondly, I will outline the similarities and differences between Quine's NE and TE as follows.

(1) They investigate the same central issue of epistemology.

All epistemologies share the same central issue: the relation between sensation and theory, or between observation and theory, or between evidence and theory—in Quine's words, between observation sentences and theoretical discourses. Both TE and NE are not exceptional:

> The relation between the meager input and the torrential output is a relation that we are prompted to study for somewhat the same reasons that always prompted epistemology; namely, in order to see how evidence relates to theory, and in what ways one's theory of nature transcends any available evidence.[58]

(2) They have different attitudes toward skepticism.

Skepticism can be divided into two kinds: global and local. Global skepticism (GS) challenges the very possibility of knowing the world and the reliability of our overall theory of the world. Local skepticism (LS), by contrast, targets the reliability of specific epistemic approaches and attainments.

Since TE—whether rationalist or the empiricist—seeks absolutely certain knowledge, skepticism poses a serious threat to its goals., TE must therefore confront skepticism directly and address questions such as: Is absolutely certain knowledge really possible? What makes knowledge possible? How is knowledge possible?

Quine completely dismisses GS, which challenges science from above, prior to, or outside of science itself—from a god's eye or transcendental perspective. GS questions the possibility of science before doing science, which Quine compare to flipping the table before eating. With GS, there is no room for negotiation. However, LS doubts scientific achievements from within science itself, so its "doubts are scientific doubts", and it is "an offshoot of science."[59] With LS, negotiation is possible. (Further discussion will follow in Section 5.)

[58] Ibid., 83.
[59] Quine, *Quintessence*, 287–288.

(3) They adopt different research strategies.

TE is a kind of armchair philosophy, primarily appealing to reflection and speculation, and has the following features: (i) it is*a priori*: "careful reflection, rather than empirical investigation, is taken to be the proper method to arrive at accurate understanding of the true epistemological principles and facts"; (ii) it is *autonomous*: "in terms of both its methods and its subject matter, epistemology is independent of the sciences"; (iii) it focuses on normative matters.[60]

Quine's strategy is radically different. Since he gives up the ideal of pursuing absolutely certain knowledge, and since, according to his holism, there is no a priori statements independent of experience, his NE focuses on a genetic approach to the actual process, mechanism, methodology, and norms of how we proceed from stimulation to science. In other words, his NE wants to defend science "from within":

> The naturalistic philosopher begins his reasoning within the inherited world theory as a going concern. He tentatively believes all of it, but believes also that some identified portions are wrong. He tries to improve, clarify, and understand the system *from within.* He is the busy sailor adrift on Neurath's boat.[61]

(4) They have different concerns and emphases.

The mainstream of contemporary epistemology still largely belongs to the type of TE that Quine criticizes. Truncellito writes, "Epistemology is the study of knowledge." "First, we must determine the *nature* of knowledge"; "Second, we must determine the *extent* of human knowledge";[62] Perhaps we could add: Third, we must establish the *norms* of human cognition. For instance, *Routledge Companion to Epistemology* centers on the concept of knowledge, consisting of ten parts: foundational concepts; the analysis of knowledge; the structure of knowledge; kinds of knowledge; skepticism; responses to skepticism; knowledge and knowledge attributions; formal epistemology; the history of epistemology; and metaepistemological issues.[63]

However, Quine's NE takes a different direction: it does not give much attention to the concept of knowledge, let alone make it the central issue. Quine writes:

> Knowledge, nearly enough, is true belief on strong evidence. How strong? There is no significant cut off point. 'Know' is like 'big': useful

[60]Rysiew, "Naturalism in Epistemology".
[61]Quine, *Theories and Things*, 72; my emphasis.
[62]David A. Truncellito, "Epistemology", *Internet Encyclopedia of Philosophy*, (2007).
[63]Sven Bernecker and Duncan Pritchard (eds.), *The Routledge Companion to Epistemology* (London and New York: Routledge, 2011).

> and unobjectionable in the vernacular where we acquiesce in vagueness but unsuited to technical use because of lacking a precise boundary. Epistemology, or the theory of knowledge, blushes for its name.[64]

Instead, Quine's NE focuses on the empirical investigation of the process of theory formation process and refines normative elements from its scientific findings.

It is worth of emphasizing that we should seriously consider Quine's discussion of the "five milestones of empiricism." Since the first three are irrelevant here, we mention only the fourth and fifth, both introduced by Quine himself. The fourth is methodological monism: the abandonment of the analytic-synthetic dualism. The fifth is naturalism: the abandonment of the goal of a first philosophy prior to natural science.[65] Since his naturalism is a stage in the development of empiricism—and empiricism is at least one kind of TE—his NE is not a replacement but a continuation of TE. He emphasizes:

> [...] epistemology still goes on, though in a new setting and a clarified status. Epistemology, or something like it, simply falls into place as a chapter of psychology and hence of natural science.[66]

His NE "is no gratuitous change of subject matter, but an enlightened persistence rather in the original epistemological problem. It is enlightened in recognizing that the skeptical challenge springs from science itself, and that in coping with it we are free to use scientific knowledge."[67]

4 Working from within rather than outside our science

In this section, I will deal with three objections to Quine's NE mentioned in Rysiew (2021): (1) "Quinean naturalism is viciously circular"; (2) its "response to skepticism is unsatisfactory"; and (3) its "position is self-defeating."[68] All these objections relate to the so-called circularity charge against Quine's NE: "Our scientific theories depend on our sensory experience, and so (says the sceptic or the anti-naturalist) we cannot legitimately appeal to those theories in explaining the possibility or actuality of perceptual knowledge (for example)."[69]

Firstly, I offer a general response to the circularity charge. According to the coherence theory of truth and Quine's holism, a substantive block of our theories about nature as a whole has empirical implications, while any

[64] Quine, *Confessions of a Confirmed Extensionalist and Other Essays*, 322.
[65] See Quine, *Theories and Things*, 67.
[66] Quine, *Ontological Relativity and Other Essays*, 82.
[67] Quine, *Roots of Reference*, 3.
[68] Rysiew, "Naturalism in Epistemology."
[69] Wrenn, "Naturalistic Epistemology."

single statement within it does not have implications in isolation. Therefore, mutual support among parts of the block is necessary—not in a linear fashion, but as a network. We may say that linear circularity is vicious, but network circularity may not be. Gila Sher points out:

> [...] we can distinguish four types of circularity: (1) Destructive circularity, (2) Trivializing circularity, (3) Neutral Circularity, and (4) Constructive circularity... We are responsible for avoiding vicious circularity, but non-vicious circularity is acceptable. Indeed, some forms of circularity are constructive, [...][70]

Therefore, the circularity charge does not generally succeed; whether it holds or not depends on the specific situations.

Secondly, I clarify Quine's concept of "science." He writes:

> In science itself I certainly want to include the farthest flights of physics and cosmology, as well as experimental psychology, history, and the social sciences. Also mathematics, insofar at least as it is applied, for it is indispensable to natural science.[71]

From this, we can see that Quine has a very broad understanding of science. He distinguishes science into two parts: hard sciences, including physics, chemistry, biology, and perhaps mathematics; and soft sciences, including history, economics, sociology, and even some philosophical theories. The core of science is usually called "natural science." Quine repeatedly emphasizes that science is continuous with common sense, and that philosophy is continuous with science. We cannot take any transcendental perspective (such as God's-eye view) to criticize or justify science from above, before, or outside science. Instead, we must investigate the ontology, epistemology, methodology, and norms of science from within: applying the methods of natural science, using its findings, and following its procedures and standards.

Thirdly, I consider Quine's response to skeptical challenges to science. As previously discussed, he directly rejects GS due to its transcendental standpoints, and pays little attention to thought experiments like Descartes' demon and Putnam's brain-in-the-vat, judging them as at least "overreacting": "Epistemology is best looked upon, then, as an enterprise within natural science. Cartesian doubt is not the way to begin."[72] He only seriously considers LS, which doubts scientific claims from within science.

LS usually appeals to illusion and hallucination to challenge our science. In real life, there are phenomena such as mirages, double images, rainbows,

[70]Gila Sher and Chen Bo, "Foundational Holism, Substantive Theory of Truth, and a New Philosophy of Logic: Interview with Gila Sher by Chen Bo", *Philosophical Forum* 50(1) (2019): 16–17.

[71]Quine, *Quintessence*, 275.

[72]Ibid., 288.

dreams, and seemingly bent sticks in water, which we later recognize as not being real. From these facts, LS concludes that we should not trust our sensory organs—eyes, ears and others—and that sensory experience is not a reliable starting point for cognition. In Quine's view, local skeptics overreact by drawing this conclusion. He asks: in what sense are those appearances illusions? He answers:

> In the sense that they seem to be material objects which they in fact are not. Illusions are illusions only relative to prior acceptance of genuine bodies with which to contrast them [...]. Rudimentary physical science, that is, common sense about bodies, is thus needed as a springboard for scepticism [...][73]

Moreover, LS raises further doubts about science from within science itself:

> Science itself teaches that there is no clairvoyance; that the only information that can reach our sensory surfaces from external objects must be limited to two-dimensional optical projections and various impacts of air waves on the eardrums and some gaseous reactions in the nasal passages and a few kindred odds and ends. How, the challenge proceeds, could one hope to find out about that external world from such meager traces? In short, if our science were true, how could we know it?[74]

Here, the local skeptic argument is as follows: in the process of cognition, we accept "meager" and two-dimensional input from the world, but produce "torrential" and three-dimensional output that constitutes our theory of the world. Since the gap between input and output is so large, how can we justify that the process of production is reasonable or even reliable? In this way, local skeptics raise doubts about science from within science.

Quine's response to this kind of skeptical challenges includes three points:

(1) The gap is filled by man's creative contribution: "Subtracting his cues from his world view, we get man's net contribution as the difference. This difference marks the extent of man's conceptual sovereignty—the domain within which he can revise theory while saving the data."[75] This is also the primary reason for the underdetermination of theory by evidence.

(2) No justification beyond observation and method is required: "Our overall scientific theory demands of the world only that it be so structured as to assure the sequences of stimulation that our theory gives us to expect."[76]

[73]Ibid., 287.
[74]Quine, *Roots of Reference*, 2.
[75]Quine, *Word and Object*, 4.
[76]Quine, *Theories and Things*, 22.

As an inquiry into reality, our science does not require justification beyond observation and the hypothetico-deductive method.

(3) We must argue from within science: In Quine's view, the arguments of LS often take this form: science suggests that science is impossible. He does not fault the skeptics for using scientific findings to challenge science—he believes their strategy is valid and the only feasible one. Since there is no vantage point above,before, or outside science—no first philosophy—any scientific findings or currently plausible conjectures may be used in philosophy and elsewhere. When legitimizing science, we must follow the skeptics' own steps and make free use of science: "[. . .] I philosophize from the vantage point only of our own provincial conceptual scheme and scientific epoch, true; but I know no better."[77]

Stroud has made serious efforts to argue that Quine does not really answer the skeptics, and that his NE either fails *as* epistemology or fails *to be* epistemology at all.[78] Quine has responded to Stroud.[79] I do not have sufficient space in this paper to examine Stroud's arguments and Quine's response in detail.

Fourthly, let us observe how Quine makes free use of achievements from different scientific disciplines in developing his NE. To establish his ontological position, he adopts physical objects from common sense and physics, and classes or sets from set theory and mathematics. To expose the ontological commitments of a theory, he employs first-order logic and semantic regimentation: "To be is to be a value of variable"[80], and "No entity without identity."[81] In developing his theory of language learning and the roots of reference, he draws on numerous theoretical achievements from linguistics, psychology (especially behavioristic psychology), anthropology, and logic. To account for expectation formation and induction rationality, he appeals to genetics and Darwinian theory of evolution—natural selection and innate endowment. Quine himself thus *really* make full and free use of science in his NE.

We return now to the charge of circularity in Quine's NE. To respond, we must take seriously Quine's own view: "There is the reciprocal containment, though containment in different senses: epistemology in natural science and natural science in epistemology."[82] Here, following Quine's NE,

[77]Quine, *Quintessence*, 108.

[78]Barry Stroud, "The Significance of Epistemology Naturalized", *Midwest Studies in Philosophy* 6(1) (1981): 455–471.

[79]W. V. Quine, "Reply to Stroud", *Midwest Studies in Philosophy* 6(1) (1981): 473–475.

[80]Quine, *From A Logical Point of View*, 15.

[81]Quine, *Ontological Relativity and Other Essays*, 23.

[82]Ibid., 83.

"epistemology" should be understood as "natural science" in its broadest sense.

Natural science contains NE in the sense that NE is one of its branches. Specifically, NE presupposes the existence of an external world. Sensory receptors—humans' points of contact with the world—are physical entities according to natural science, particularly anatomy and physiology. The two cardinal tenets of NE, namely that (1) "whatever evidence there is for science is sensory evidence" and (2) "all inculcation of meanings of words must rest ultimately on sensory evidence",[83] are themselves findings of natural science. NE contains natural science in the sense that its subject matter is the entire body of natural science: it seeks to understand the general dynamics and structure of science as a whole. Moreover, the ontology of natural science is projected from our epistemological research.

Quine continues: "This interplay is reminiscent again of the old threat of circularity, but it is all right now that we have stopped dreaming of deducing science from sense data."[84] We might add: it is also all right now that we have stopped pursuing absolutely certainty in science. Since there is no Archimedean standpoint external to science, we must settle for understanding and vindicating science from within science. If this is circularity, it is not vicious, but constructive. Constructive circularity is not only acceptable—it is the only viable option left to us, given that science is a connected whole and we are, like Neurath's sailors, afloat on a boat that we must repair from within. I assert that Quine's NE cannot be properly understood without grasping the reciprocal containment of epistemology and natural science, and that the so-called "circularity" charge largely stems from disregarding or misinterpreting Quine's view of this reciprocal relationship.

5 Reinterpreting rather than disregarding normativity of epistemology

A common and persistent criticism of Quine's NE is its alleged non-normativity. This view widely shared among philosophers such as Putnam (1982), Davidson (1986), Kim (1988), Siegel (1990), with Kim critique (1988) being especially influential.[85] Consider the following quotations from two representative sources:

[83] Ibid., 75.

[84] Quine, *Ontological Relativity and Other Essays*, 83–84.

[85] See Hilary Putnam, "Why Reason Can't Be Naturalized", *Synthese* 52(1) (1982): 3–23; Donald Davidson, "A Coherence Theory of Truth and Knowledge", in *Truth and Interpretation: Perspectives on the Philosophy of Donald Davidson*, ed. E. LePore (Oxford: Blackwell, 1986), 307–319; Jaekwon Kim, "What is 'Naturalized Epistemology'?", *Philosophical Perspectives* 2 (1988): 381–405; Harvey Siegel, "Laudan's normative naturalism", *Studies in History and Philosophy of Science* 21(2) (1990): 295–313.

> [I]n recasting epistemology as "a chapter of psychology", Quine is stripping away any concern with epistemic normativity. [...] The complaint here is not merely that normativity is a feature of TE [...]; it is that a concern with normative epistemic matters is essential to epistemology *per se*.[86]

> One of the most resilient global complaints [of Quine's NE] is what may be called the "normativity charge", that naturalized epistemology is a merely descriptive enterprise and therefore unfit to succeed the essentially normative traditional theory of knowledge.[87]

In this section, I will show how Quine himself responds to the non-normativity charge, and what epistemic norms he proposes in his NE. In doing so, I am to do justice to his project and defend it against the non-normativity accusation.

First, Quine explicitly refutes the charge that NE is devoid of normativity. He explains:

> Naturalization of epistemology *does not jettison the normative* and settle for the indiscriminate description of on-going processes. For me normative epistemology is a branch of engineering. It is the technology of truth-seeking, or, in more cautiously epistemic terms, prediction. Like any technology, it makes free use of whatever scientific findings may suit its purpose.[88]

> Traditional epistemology was in part normative in intent. Naturalistic epistemology, in contrast, is viewed [...] as purely descriptive.*I disagree.* Just as traditional epistemology on its speculative side gets naturalized into science, or next of kin, so *on its normative side it gets naturalized into technology, the technology of scientizing.*[89]

Indeed, as Quine claims, epistemic norms are *naturalized* in his NE: they are derived from past success of scientific practice. Certain procedures and methods in science consistently yield results that are efficient and beneficial and thus are taken to be truth-indicative. Accordingly, they should guide future inquiry. In this way, epistemic norms are extracted from and supported by the findings of natural science. Quine offers a clear example:

> What are more distinctively naturalistic and technological are *norms based on scientific findings.* Thus science has pretty well established—subject to future disestablishment, as always—that our information about distant events and other people reaches us only through impact

[86]Patrick Rysiew, "Naturalism in Epistemology".

[87]Wybo Houkes, "Normativity in Quine's Naturalism: The Technology of Truth-Seeking?", *Journal for General Philosophy of Science* 33(2) (2002): 251–267.

[88]Hahn and Schilpp (eds.), *The Philosophy of W. V. Quine*, 664–665; my emphasis.

[89]Quine, *Quintessence*, 282; my emphasis.

> of rays and particles on our sensory receptors. A normative corollary is that we should be wary of astrologers, palmists, and other soothsayers.[90]

Second, Quine proposes several epistemic norms in his NE:

(1) Seek truth! Avoid error!

In 1990, Quine published his penultimate book, *Pursuit of Truth*. This phrase aptly captures the goal of his philosophical endeavor: from his early career to his later years, truth remained central to his work.[91] I reformulate this phrase into an epistemic imperative: "Seek the truth!" Quine writes:

> For me, normative epistemology is a branch of engineering. It is *the technology of truth-seeking*, [...]. There is no question here of ultimate value, as in morals; *it is a matter of efficacy for an ulterior end, truth or prediction.* The normative here, as elsewhere in engineering, becomes descriptive when the terminal parameter has been expressed.[92]

"Seek truth!" should be recognized as a first-class epistemic norm in Quine's NE for two reasons: (1) It is not only our primary cognitive goal but also a crucial means for survival. Without a truthful understanding of our environment, we risk harm and eventual elimination. (2) Truths summarize humanity's priori cognitive achievements and serve as normative guides for future exploration. They illuminate directions, paths, methods, strategies, rules and principles for ongoing inquiry.

A corollary of this imperative is "Avoid mistake and errors!". Quine argues:

> There is some encouragement in Darwin. If people's innate spacing of qualities is a gene-linked trait, then the spacing that has made for the most successful inductions will have tended to predominate through natural selection. *Creatures inveterately wrong in their inductions have a pathetic but praiseworthy tendency to die before reproducing their kind.*[93]

In other words, if we hope to survive and reproduce, we must avoid error and mistakes.

In Quine's NE, then, epistemic normativity is simply a matter of instrumental efficacy—of deploying cognitive means that reliably produce successful predictions. It derives from causal connections between practice and outcome, and from the historical record of scientific achievement.

[90] Ibid., 282; my emphasis.

[91] Chen Bo, "Quine's Disquotationalism: A Variant of Correspondence Theory of Truth", *Philosophical Forum* 51(2) (2020): 93–113.

[92] Hahn and Schilpp (eds.), *The Philosophy of W. V. Quine*, 664–665; my emphasis.

[93] Quine, *Ontological Relativity and Other Essays*, 126; my emphasis.

Though science remains fallible, it is highly unlikely to be wholly mistaken. Thus, normative epistemology "gets naturalized into a chapter of engineering: the technology of anticipating sensory stimulation."[94]

(2) The first cardinal tenet of empiricism.

Quine identifies two cardinal tenets of empiricism, the first being that "whatever evidence there is for science is sensory evidence."[95] He elevates this tenet to normative status in his NE:

> The most notable norm of naturalized epistemology actually coincides with that of traditional epistemology. It is simply the watchword of empiricism: *nihil in mente quod non prius in sensu*. This is a prime specimen of naturalized epistemology, for it is a finding of natural science itself, however fallible, that our information about the world comes only through impacts on our sensory receptors. And still *the point is normative*, warning us against telepaths and soothsayers.[96]

In my view, the watchword of empiricism is identical to its first cardinal tenet. In this passage, Quine emphasizes: (1) the first tenet functions as an epistemic norm; (2) it is shared by both NE and traditional empiricist epistemology; (3) it is supported by empirical findings and thus inherits their reliably. Empiricism itself is "the crowning norm" of NE.[97]

(3) The hypothetico-deductive method and predictive testing.

In Quine's NE, the hypothetico-deductive method (HDM) is virtually synonymous with the scientific method and serves as a central epistemic norm:

> What might be offered *first of all as a norm of naturalized epistemology is prediction of observation as a test of a hypothesis. I think of this as more than a norm: as the name of the game.* Science cannot all be tested, and the softer the science the sparser the tests; but when it is tested, the test is prediction of observation. Moreover, naturalism has no special claims on the principle, which is rather the crux of empiricism.[98]

Quine claims that prediction, made possible through HDM, is essential for testing hypotheses and ensuring their empirical content. It namely links observable predictions with theoretical hypothesis, making the latter testable by experience and thus scientific. He thus emphasizes that the game of

[94]Quine, *Pursuit of Truth*, 19.
[95]Quine, *Ontological Relativity and Other Essays*, 75.
[96]Quine, *Pursuit of Truth*, 19; my emphasis.
[97]Ibid., 21; my emphasis.
[98]Quine, *Quintessence*, 282; my emphasis.

science is *defined* by the strategy of conjecturing within scientific hypotheses. As he puts it: "A sentence's claim to scientific status rests on what it contributes to a theory whose checkpoints are in prediction."[99]

(4) Normative considerations in hypothesis selection.

Beside these major epistemic norms, Quine also acknowledges a range of heuristic norms that guide hypothesis formation and selection in scientific inquiry. He notes:

> For a richer array of norms, vague in various degrees, we may look to the heuristics of hypothesis: how to think up a hypothesis worth testing. This is where considerations of conservatism and simplicity come in, and, at a more technical level, probability. In practice those technical matters spill over also, as I remarked, to complicate the hypothetico-deductive method itself.[100]

When faced with competing hypotheses, scientists must assess their relative merits. Quine proposes several desirable traits of good hypotheses, which might guide us in selecting the best of them. In his paper "Posits and Reality", in addition to correctness of predictions, he lists: simplicity, familiarity of principle, scope, and fecundity.[101] In *The Web of Belief* (1970), coauthored with Ullian, Chapter 6 and parts of Chapter 7 elaborate six virtues of plausible hypotheses: conservatism, modesty, simplicity, generality, refutability, and precision.[102] In *From Stimulus to Science* (1995), he emphasizes just two: "conservatism, or the maxim of minimum mutilation, and simplicity, familiar in ontological contexts as Ockham's razor."[103] Importantly, "[...] as Quine notes, the various virtues can conflict; they must be balanced off against one another in particular cases."[104]

So far, I think we can conclude that the non-normativity charge against Quine's NE is not well grounded. In a conversation with me, Chung-ying Cheng points out that Quine's naturalism is rational naturalism. I agree and consider this a deep insight. In my view, Quine's rational naturalism consists of the following elements: scientific realism, that is, there is a real world which science repeatedly discloses to us; empiricism, namely, our theory of

[99] Quine, *Pursuit of Truth*, 20.
[100] Quine, *Quintessence*, 282.
[101] See W. V. Quine, *The Ways of Paradox and Other Essays* (New York: Random House. 2nd revised and enlarged edition, 1976), 247.
[102] W. V. Quine and Joseph S. Ullian, *The Web of Belief* (New York: Random House, 1970; second edition, 1978).
[103] Quine, *From Stimulus to Science*, 49.
[104] Penelope Maddy, "Three forms of naturalism", In *Oxford Handbook of Philosophy of Mathematics and Logic*, ed. Stewart Shapiro (Oxford: Oxford University Press, 2005), 437–459.

the world ultimately originates from our sensory experience of it; HDM—that is, we formulate hypotheses about the world on the basis of sensory experience and theoretical reasoning, deduce a series of predictions that are confirmable or falsifiable by experience, and thereby gradually progress in our understanding of the world; and naturalism, i.e., there is no tribunal beyond science to which science itself must answer.

Furthermore, consider the following questions: How do we justify epistemic, legal, ethical and other norms? Why do we "must" or "ought" to do something? Why should we do this but not that, or do it this way rather than that way? What is the source of normativity? To answer these questions, I think Hume's "is-ought" division is not a good starting point and should rather be rejected. We should follow Quine's lead in naturalizing normativity. My general idea is this: following the American classical pragmatists, we should place humanity's interests, desires, needs and wants at the forefront. We know what we have to know, and we know what we are able to know. Facts are not completely objective, as they are shaped by human cognition; norms are not entirely subjective, since they have a factual basis in the world and reasons in academics. To justify a variety of norms, we must consider at least three important elements: first, our interests, desires, needs and wants, etc., which set the aims and purposes of our cognition; second, the gap between our purposes and the actual situation; and third, how to bridge this gap between the two according to our best theory about the world. I have developed these ideas in a long Chinese paper.[105]

6 Against Williamson's critics of naturalism

In his short essay "What is Naturalism?" (2016), Williamson expresses skepticism toward naturalism, criticizing both its metaphysical claim—"there is only the natural world"—and its methodological claim—"the best way to find out about it is by the scientific method."[106] Although he mentions Quine only once, I judge that his critics are effectively directed at Quine's naturalism, or at least apply to it. I will respond to his critics in my own order.

Williamson's critic 1 targets the methodological aspect of naturalism: "What is meant by 'the scientific method'? Why assume that science only has one method?" and "One challenge to naturalism is to find a place for mathematics."[107] I think this critic is quite unfair. For Quine, as shown above, HDM is virtually synonymous with the scientific method and

[105]Chen Bo, "Why do we 'must' and 'should'? Bridging the gap from 'Is' to 'Ought'" [in Chinese], *Social Science in China* 11 (2024), 47–65.

[106]Timothy Williamson, "What is Naturalism?" in *The Stone Reader: Modern Philosophy in 133 Arguments*, eds. P. Catapano and S. Critchley (New York: Norton/Liveright, 2016), 243.

[107]Ibid., 243.

functions as a central epistemic norm—not merely "one method" or "a single general method", as Williamson says. For Quine, HDM encompasses a range of procedures and methods: preparing primitive data for a hypothesis, formulating the hypothesis, deducing a series of consequences (including observable predictions), logically or empirically testing the hypothesis, and selecting the best available hypothesis based on the normative considerations discussed earlier. Therefore, HDM serves as an umbrella term for a series of scientific methods—indeed, the totality of methods used in science, possibly including speculation in philosophy.[108] In this sense, HDM and the scientific method are effectively equivalent.

In recent years, Williamson himself strongly endorsed abductive methodology in philosophy, even advocating what he calls "abductive philosophy."[109] For him, "abduction" is also an umbrella term—not a single method but a set of methods, not clearly delineated. In my judgment, his "abduction" is very close to Quine's HDM. Therefore, if critic 1 is applicable to Quine's NE, it is equally applicable to Williamson's own "abductive philosophy."

Now let me clarify the role of mathematics in Quine's NE. In defense of mathematical realism and mathematical truths, Quine constructs his indispensability argument. He contends that mathematical objects are essential to science; the practical success of science confirms not only its assumptions about the material world—including unobservable physical objects—but also its mathematical axioms and objects, even though these do not exist in time and space or causally interact with our senses. He continues:

> In science itself I certainly want to include the farthest flights of physics and cosmology, as well as experimental psychology, history, and the social sciences. Also mathematics, insofar at least as it is applied, for it is indispensable to natural science.[110]

According to the understanding of HDM outlined above, both logical and mathematical methods—especially logical inference and mathematical proof—fall within the scope of HDM. Hence, both logic and mathematics, when employing those methods, belong to the domain of science.

Of course, Quine's naturalist account of mathematical objects and truths is broad-brush, lacking necessary detail and subject to certain internal intensions. Maddy and Sher have made significant efforts to continue and refine Quine's sketchy philosophy of mathematics. By focusing on set-

[108]Ibid., 297.

[109]See Timothy Williamson, "Abductive Philosophy", *Philosophical Forum* 47(3–4) (2016): 263–280.

[110]Quine, *Quintessence*, 275.

theoretical objects and methodology, Maddy first developed her naturalism in mathematics, and later her broader "second philosophy" of mathematics.[111]

In my view, Sher's philosophy of mathematics is more promising. She argues that both logic and mathematics are grounded in the world and in our minds, and that all logical and mathematical truths are based on correspondence with the world. More specifically, mathematical truths correspond to the formal features and structural properties of objects. In her account, Individuals (0-level objects) have formal property of self-identity; properties of individuals (1^{st}-level objects) have formal properties such as cardinality; and relations between individuals (1^{st}-level objects) possess formal properties like reflexivity, symmetry, and transitivity.

Sher uses invariance under isomorphisms to precisely characterize the formality of mathematics and illustrates her correspondence account of mathematical truths as shown in Figure 1.[112]

Composite Mathematical Correspondence

1st-Order Language: "$2 + 7 = 9$" is true

iff

Posits: $+(2, 7) = 9$

iff

Reality: $\text{DISJOINT-UNION}(\text{TWO}, \text{SEVEN}) = \text{NINE}$

[*iff*

$(\forall P1)(\forall P2)((\text{TWO}(P1)\ \&\ \text{SEVEN}(P2)\ \&\ P1 \cap P2 = \varnothing) \supset \text{NINE}(P2 \cup P2))]$

FIGURE 1. Sher's illustration of her correspondence account of mathematical truths.

By outlining Quine's, Maddy's and Sher's philosophy of mathematics, I simply want to show that it is, in principle, possible to develop naturalist explanation of the place of mathematics in the whole of sciences. Therefore, Williamson's comment that "One challenge to naturalism is to find a place for mathematics" is at least answerable.

Williamson's critic 2 targets the naturalistic concept of science. He constructs a "dilemma" for naturalists (mainly Quine) as follows:

[111] Penelope Maddy, *Naturalism in Mathematics* (New York: Oxford University Press, 1997); *Second Philosophy: A Naturalistic Method* (New York: Oxford University Press, 2007).

[112] Gila Sher, "Truth & Knowledge in Logic & Mathematics", in *The Logica Yearbook 2011*, eds. M. Peliš & V. Punčochář (London: College Publications, King's College, 2012), 294.

> If they are too inclusive in what they count as science, naturalism loses its bite. [...] But if they are too exclusive in what they count as science, naturalism loses its credibility, by imposing a method appropriate to natural science on areas where it is inappropriate. Unfortunately, rather than clarify the issue, many naturalists oscillate.
>
> When on the attack, they assume an exclusive understanding of science as hypothetico-deductive. When under attack themselves, they fall back on a more inclusive understanding of science that drastically waters down naturalism. Such maneuvering makes naturalism an obscure article of faith. I don't call myself a naturalist because I don't want to be implicated in equivocal dogma.[113]

I do not think this "dilemma" is real for Quine's NE, because I disagree the first alternative: "If they are too inclusive in what they count as science, naturalism loses its bite." This is not true. In Quine's view, even Descartes' dualism of mind and body has both a "scientific" and a "speculative" side. Insofar as its "scientific" side is concerned, "it could as well be reckoned as science, however false. He even had a causal theory of the interaction of mind and body through the pineal gland."[114] Insofar its "speculative" side is concerned—for example, Descartes' quest for absolute certainty and his demon argument, which transcends all the available scientific evidence—it should be rejected as unscientific first philosophy. For Quine, even religion could be regarded either as a part of science or as pure belief. If considered part of science, we must evaluate the rationality of certain religious claims like "God exists", mainly by appealing to empirical evidence and rational arguments. If considered pure belief, religion lies beyond the scope of scientific discourse and cannot be governed by evidence and reason. Therefore, even though Quine's concept of science is very inclusive, it does not lose its bite.

Williamson's critic 3 concerns the metaphysical aspect of Quine's NE. He asks:

> What [...] is the natural world? If we say it is the world of matter, or the world of atoms, we are left behind by modern physics, which characterizes the world in far more abstract terms. Anyway, the best current scientific theories will probably be superseded by future scientific developments. We might therefore define the natural world as whatever the scientific method eventually discovers. Thus naturalism becomes the belief that there is only whatever the scientific method eventually discovers, and (not surprisingly) the best way to find out about it is by the scientific method. That is no tautology. Why can't there be things only discoverable by nonscientific means, or

[113]Williamson, "What is Naturalism?", 243–244.
[114]Quine, *Quintessence*, 275.

> not discoverable at all? Still, naturalism is not as restrictive as it sounds.[115]

To answer Williamson' question, we must keep three points in our mind: (i) Quine's concept of science is very broad, so modern physics, as Williamson mentions, is included; (ii) for Quine, "[...] it is within science itself, and not in some prior philosophy, that reality is to be identified and described";[116] (iii) scientific conclusions are broadly grounded in evidence and reason. Since we are not able to observe the world from a standpoint outside of science: "the notion of reality is itself part of the apparatus; and sticks, stones, atoms, quarks, numbers, and classes all arc utterly real denizens of an ultimate real world, except insofar our present science may prove false on further testing."[117] Only through science can we know that there are unknown parts of the world. Even such philosophical claims as "there is an external world" or "there are external objects" are summaries and projection of humanity's accumulated experience and cognition. As the ongoing extension of human cognitive boundaries reveals more and more about the previously unknown world, we infer by induction that such progress will continue, and that there is an external world independent of what or how we know.

As for Williamson's question—"Why can't there be things not discoverable at all?"—science itself offers a negative answer, by continuously extending our cognitive boundaries. Science can recognize that unknown things exist in the world, but it does not commit to the idea that there are things in principle unknowable. I myself find it difficult to articulate a scientific reason for the existence of such unknowables.

Regarding the further question—"Why can't there be things only discoverable by nonscientific means?"—Quine's answer might be this: while we cannot deny the possibility of nonscientific discovery, the history of human cognition has repeatedly shown that such methods are typically fraught with error, fallacy, and even absurdity, and are far less reliable than scientific methods. As Quine puts it: "Science reveals hidden mysteries, predicts successfully, and works technological wonders."[118] "[...] in our pursuit of truth about the world we cannot do better than our traditional scientific procedure, the hypothetico-deductive method."[119] Even though science is fallible in principle, it is highly improbable that it is completely wrong. Thus, scientific methods remain the most successful, the most reliable, and the best tools we have for understanding the world in which we live.

So far, I think I can conclude that Williamson's three critics against naturalism—particularly Quine's variety—do not hold.

[115]Williamson, "What is Naturalism?", 243.
[116]Quine, *Theories and Things*, 21.
[117]Quine, *Quintessence*, 285.
[118]Quine, *Ontological Relativity and Other Essays*, 133.
[119]Quine, *Quintessence*, 281.

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Judgment and the quest for knowledge in science

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Abstract. Although we tend to view science as focused on facts and logical analysis of objective information, assessing scientific proposals involves complex discussions based more on judgments than formal rules, especially in the more general disciplines. This paper explores the matter using as a launchpad two related episodes representative of current science. One focuses on the introduction and critical reception of Albert Einstein's theory of special relativity, notably how it led to reconsidering epistemic values in accepting and rejecting ideas. The second episode is Niels Bohr's defense of quantum mechanics in the Solvay Conference in 1927 and afterward, which uses Einstein's approach. These episodes transformed modern science. Their impact on epistemic values is a central topic of this paper. The results show how strongly legal-like deliberative thinking is consubstantial with contemporary science.

Background

The decline of logical empiricism in the 1950s revived interest in the character of scientific decisions. Some philosophers, notably Stephen Toulmin, noted that scientific verdicts typically involve a balance of gains and losses achieved through careful judgment, like in the practice and study of law. In *The Uses of Argument* (1958) and later in *Human Understanding*(1972), Toulmin discusses connections between jurisprudence and the philosophy of science, jurisprudence understood as the study of judicial decisions that cannot fully follow strict rules. The philosophy of science of the 1960s developed a growing consensus that the ideal of perfectly rule-governed rational deliberation does not fit contemporary scientific practice. One reason is that scientific proposals in a domain vary with respect to the benefits they provide. Scientists need to decide how much ground to give up on one front (for example, predictive power) in exchange for progress on another (for instance, descriptive simplicity). The examples used by Toulmin include Einstein's argument for the Special Theory of Relativity in the 1900s and, from a little later in the story, the debate surrounding the rise of Quantum Mechanics.

Between 1880 and the first years of the 20th century, high-precision experiments aimed at measuring the relative speed of the medium of light (the so-called "luminiferous aether") showed a systematic inability to achieve such a measurement. A view widely accepted at the time as a "truth of

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Comptes Rendus de l'Académie Internationale de Philosophie des Sciences 4 (2025).
A. Cordero, Judgment and the quest for knowledge in science, pp. 49–59.

reason" dictated that light waves require a medium to arise and propagate. But whatever that medium was, relative to the devices used to do the measurement on Earth, the speed of light appeared not to change. Studies of empiricist epistemology helped to break the impasse. Especially the work of Ernst Mach (keenly read in some circles of theoretical physics) led Einstein to make a blunt proposal. Since the speed of the luminous medium resists empirical scrutiny, we should leave the ether intellectually aside and accept the speed of light as a universal constant. Though outrageously against both common sense and the conceptual basis of previous physics, this idea is a central tenet of Einstein's 1905 Special Theory of Relativity (SRT). SRT abounds in rebellious conceptual implications—notably the relational character of the "present time", which in STR is not the same across *all* reference systems (as it was in prior physics).

Einstein's train of reasoning on these fundamental matters was not properly rule-governed. Technically, his arguments were informal. Still, the disputes they generated did proceed in terms of explicit reasons open to criticism. Commenting on those disputes, Toulmin emphasizes the resemblance of the arguments at play to common law arguments, where often a loose procedure satisfactorily resolves the issue at hand. In the two historical cases mentioned, the soundness of the proposed strategy rested on future projections rather than synchronous evaluations. While the research was still in full flight, deciding which envisioned option will lead to more fruitful explanations could only be based on "rational bets."

Epistemic Values and Scientific Verdicts: Two Historic Deliberations

(1) The Special Theory of Relativity (STR). STR challenged some of the traditional metaphysical underpinnings of physics, radically changing the conduction of theorizing. One fundamental contribution concerned the relative weights of the virtues associated with "good theories" (notably, intelligibility, predictive power, and simplicity). Einstein's shift to a working-level (functional) conception of the ontology of waves was no less crucial. His description of light and electromagnetic waves abstracts the latter from the conceptual scheme that had been their traditional home, where light waves occurred as "modes of being" of the luminiferous ether, not as independent entities. The philosophical impact of this move on the "mechanical intelligibility" of electromagnetic waves is radical. Together, the two changes mentioned allowed Einstein to conceptually integrate the strange principles of STR with abstract versions of fruitful parts of Maxwell's theory. Here Einstein was investing intellectually in a strategy whose fertility and soundness (or lack thereof) could only be decided in the future. In STR, postulating the speed of light invariance favors epistemological empiricism and theoret-

ical simplicity. This preference takes place at the cost of coherence with traditional metaphysics.

Neither scientists nor philosophers then (or have now) had a consensus on the strategy to follow, much less a formal rule for making quick decisions in cases like this. It took time to appreciate the scientific consistency and fertility of Einstein's choice, which remained the subject of intense reflection throughout the rise and fall of logical empiricism. The resulting deliberations led to insightful acknowledgments by historically oriented philosophers of science in the 1970s and 1980s. It was now clear that the acceptance and rejection of theories constitute a sophisticated form of value judgment. Another acknowledgment was that scientists disagree on the relative weights they assign to different epistemic values. Regarding the critical appraisal of STR, philosophical historians of science like Ernan McMullin (1983) showed how simplicity and consistency with background theories competed for primacy. This lack of fundamental evaluative consensus—he urged—explains why controversies, far from being rare in modern science, are a persistent and omnipresent occurrence, especially at the highest discursive levels[1].

(2) Quantum Mechanics. In foundational studies, Einstein's epistemological and methodological strategy for STR has remained strong. Early influences are apparent in the work of Niels Bohr—in his 1913 semiclassical model of the hydrogen atom and later in his contribution to the development of quantum mechanics. It appears prominently in Bohr's criticism of Einstein's, B. Podolsky's, and N. Rosen's 1935 rejection of the presumed fundamental character of quantum mechanics (the famous "EPR argument"). The influence of Bohr's revisionism is most noticeable in his appeal to a relational conception of dynamic properties, a response to EPR explicitly based on how Einstein's suspension of traditional metaphysical principles had advanced STR. According to the EPR argument, a system of two interacting particles will forever display a mysterious instantaneous interface. Specifically, an operation performed on one of them would instantly modify the state of the other regardless of how far apart they were at the time. Such an action involves entanglement between the two particles that contravenes previous physics—specifically, it goes against the classic principles of determination, separability, and spatiotemporal locality. And it is something we do not observe in everyday life. According to Einstein, Podolsky, and Rosen, the correct conclusion was that quantum mechanics is an empirically adequate but ontologically incomplete theory. In their view, the real world violates classical principles only at the surface level—at a deeper level lies a world of fully determinate, separable, and non-instantaneously interacting entities—a part of reality that quantum mechanics misses. The EPR argu-

[1] See, for example, Toulmin 1958; McMullin 1983,1989; Mary B. Hesse 1974, 1980; and Dudley Shaper 1984, 1987.

ment notwithstanding, Bohr stuck to his position, backing it with arguments drawn from early "Einsteinian" revisionism. The result was a way of thinking about physics—diffusely titled "The Copenhagen Interpretation" (CI).

On the one hand, CI posited the existence of limits to physical intelligibility. On the other hand, it led to extraordinary scientific fecundity in numerous areas of physical application—general quantum mechanics, atomic and molecular physics, condensed matter, and quantum field theory, among others. On the downside, the limits placed on intelligibility seemed highly arbitrary. A significant dark aspect of the proposed doctrine is the privileged epistemological and ontological status given to measurement processes. CI blocks the description of measurements by putting them under a veil of mystery. Instead of explaining what happens when they are performed, and more generally, outside the range of natural perception, all CI offers is "black box" approaches based on a mysterious rule—the quantum algorithm. Like Einstein, numerous physicists and thinkers considered the explanatory poverty of the Copenhagen approach appalling. Critics saw a commitment to obscurantism in CI. It was not acceptable, they argued, to have such poverty enshrined in the theory that allegedly provided the most fundamental physical explanation of material systems. The EPR argument expresses their intellectual discontent.

Realist Revivals

Frustration with CI intensified in the 1950s and 1960s. Developments such as Bell's theorem and its experimental adaptations made it conceivable to explore empirically whether nature respected the classical principles of determination, separability, and locality. Many of the first experiments conducted favored quantum mechanics. Subsequent tests confirmed the trend, strongly suggesting that it was impossible to maintain the three principles mentioned—at least one had to go. By the end of the 1980s, there was broad agreement that experiments based on generalizations of Bell's theorem had tipped the epistemological balance towards quantum mechanics against both classical metaphysics and the interpretive restrictions imposed by CI. "Ontic" proposals—so-called because they take the quantum state as representing something physically real—prospered. One result was a revival of interest in the ontology and foundations of quantum mechanics, now detached from radical empiricism.

Since the mid-1980s, three approaches have dominated ontic proposals (see, e.g., Cordero 2001, 2019): Bohmian Mechanics (BM); Many-Worlds Quantum Mechanics (MW), pioneered by Hugh Everett in the 1950s; and spontaneous collapse theories that postulate stochastic discontinuous changes of the quantum state (SC)[2]. Critics found that the first versions of these ontic

[2]E.g., the proposals by GianCarlo Ghirardi and his collaborators.

proposals needed more clarity and coherence. Improved offers, developed since 1990, draw on working-level (functional) approaches and effective (as opposed to exact) descriptions of the ontologies of ordinary quantum mechanics and quantum field theory. The ensuing ontic proposals describe physical worlds that differ among themselves and yield some divergent predictions, making it possible, in principle, to choose between them in the laboratory. Unfortunately, however, all the disagreements predicted occur in areas empirically inaccessible to present technology.

Which of the mentioned ontic proposals is more convincing? For now, none of them wins in terms of achievable predictions. In practical terms, the three approaches are "effectively equivalent." They differ, however, concerning virtues other than predictive power, mainly simplicity, epistemic modesty, range of application, fertility, and explanatory power. These differences invite divergent selections of the "best option" (Cordero 2001, Callender 2020), highlighting the ongoing debate and the need for further research in our dynamic field.

Bohmian Mechanics rejects the Copenhagen Interpretation and focuses on what is physically real instead of merely "observable"—it concentrates on "beables", not "observables". "Beables" are objects held to be elements of reality whose objectivity does not depend on "observation." They are things or properties existing in the physical world. In BM, the beables are particles (entities that always have precise positions). According to some thinkers, BM is preferable to the other ontic proposals because, as the claim goes, BM surpasses them in clarity and explanatory power (see, for example, Jean Bricmont 2016).

On the other hand, as Craig Callender (2020) notes, advocates of Many-Worlds—MW (notably David Wallace)—underscore that only their theory explains all known physical phenomena. According to Wallace, this consideration makes MW the winning option based on the diversity of phenomena it explains. Critics disagree. A recurring charge against MW is that it makes the concept of probability too problematic, unlike theories such as BM or SC. In turn, SC defenders emphasize the extravagances MW and BM go to save the ontologies they postulate (effectively parallel worlds and a surreal Bohmian particle ontology, respectively). By contrast, SC theories—assert their defenders—are the most economical and straightforward. For this reason, they urge SC theories to be preferred and prioritized when selecting the best ontic proposal. In the current disputes over ontic quantum theories, the values invoked by the contending parties compete, much as they had earlier on in the deliberations on the Special Theory of Relativity and the Copenhagen Interpretation.

Which of the contenders provides the best approach? Again, as with STR and later CI in the 20th century, the question invites judicious deliberation.

The values at stake pull in different directions. Admittedly, however, our understanding of the physical circumstances and epistemic conditions may change in the future. For example, it might become feasible to discern experimentally between the conflicting ontologies, or one might prove more fruitful than the others. Still, whatever happens in the future, the episodes highlighted in this and previous sections exemplify the priority of judgment in scientific decision-making and its diachronic and refutable character..

Realism and Inference to the Best Explanation

In *The Structure of Scientific Revolutions* (1962), Thomas Kuhn argued against linear scientific progress, emphasizing that each theory has concepts that differentiate it from other theories. This circumstance, he urged, makes expressions extracted from different theories "incommensurable" because one cannot legitimately compare the terms involved. And, he went on, even when the concepts involved don't vary, realist interpretation is overshadowed by the availability of multiple theories that explain the relevant data, even within the same framework of epistemic values. These ideas became central to the epistemology of Paul Feyerabend (1975a) and the doctrine of "underdetermination of empirical theories by experience" (UTE). His claims of radical dependency of reference on the conceptual networks of theories led to subjectivist and relativist attitudes that gained strength in the 1970s and 1980s. Passionate debates took place about the viability of scientific realism within the new historical turn in the philosophy of science.

One broad sector of scientific realists stressed the justificatory role of explanatory power, arguing that explaining a phenomenon (or theoretical structure) makes it more plausibly truthful. The participating realists presented "Inference to the best explanation" (IBE) as a form of "abductive" reasoning that substantiates a hypothesis on the premise that it provides the best explanation for the available data. Richard Boyd (1981) highlighted the historical success of IBE and shaped the approach for a generation. He advised that the methods used by modern scientists to design theories and choose between them have consistently led to instrumentally adequate proposals. In Boyd's view, the reliability of the recommendations thus endorsed is*explained* by assuming that they are approximately true. Boyd uses abductive argumentation to claim that the abductive methodological rule is probably reliable. Although the argumentation is blatantly circular, it allegedly leads to better and more fruitful explanations. If that is correct, then the circularity involved is "virtuous" rather than "vicious" (a type that only gives empty explanations). For this reason, realists in Boyd's camp think IBE deserves rational acceptance.

Like McMullin, IBE proponents point to features that—they think—enhance the plausibility of explanations. Those features include descriptive

depth beyond the observable level, domain breadth, simplicity, unifying power, predictive accuracy, internal consistency, external consistency, fertility of results, and other epistemic virtues already noted in this paper. From this perspective, the crucial point is that each instance of IBE generates a certain amount of justification for the total theory under evaluation. Following Matthias Egg (2020), I will call this line of the IBE project "IBE-theoretical" (IBE-T).

Nevertheless, antirealist complaints make trouble for IBE arguments in the contemporary debate. This concern is particularly apparent in the underdetermination of theories by experience—the UTE charge. UTE problematizes the realism inherent in IBE-T. As in the noted ontic theories of quantum mechanics, the epistemic values identified by IBE-T proponents generally lead to multiple selections of "best theory", all compatible with the available data. At any rate, no matter how strongly empirically adequate an explanation may be, it will not admit realist commitment unless it is free of competitors as successful as her. At best, then, the IBE approach needs work.

A complementary line of objections challenges the presumed realist link—the idea that the empirical success of a theory indicates truth content. The most influential project of this type elaborates on Larry Laudan's (1981) confutation of convergent realism. Here, antirealists use the history of science as a basis for skeptical inductions (SI). Laudan's refutation of the supposed realist link invokes the numerous theories that, having shown splendid success, then proved not only wrong but wrong at the level of their central assertions.

The most compelling realist responses to SI make two claims. They accept that theories taken as whole descriptive constructs probably get something wrong. But then, they also try to preserve a limited version of the link between empirical success and truth, now confined to certain parts of the theories. The resulting realist projects follow the umbrella term "Selectivism;" they counter SI and UTE objections by identifying truthful parts in empirically successful theories. A typical example of a selectivist application is how Einstein's STR abstracts electromagnetic waves from the luminiferous ether and much of the underpinning ontology of nineteenth-century physics.

Selectivism makes for a more restrictive variety of IBE than IBE-T. While the latter selects complete theories (which include the entities, laws, and relationships proposed by each theory), IBE-selectivist limits the descriptive content to theoretical parts that satisfy strict selection criteria. One problem, however, is the difficulty of prospectively identifying the sought theory parts—i.e., without vitiating the project with merely retrospective identifications. Critics thus urged selectivists to clarify and refine their strategy. Recent

positions have enhanced immunity to anti-realist criticism (Cordero 2017, Egg 2021), but challenges remain, notably the theory parts selected still face UTE-type charges. Realists currently focus on two related projects: causal selectivism and working-level (functional) selectivism. Here, I will focus on causal realist approaches (the following conclusions also apply to functional approaches; see Cordero 2017).

Causal realism (IBE-C) continues contributions that began in the 1980s, particularly from influential figures such as Nancy Cartwright (1983). The most recent and influential works in this field include those of Anjan Chakravartty (2007), who has made significant contributions to the understanding of causal properties, Mauricio Suárez (2008), and Matthias Egg (2021), among others. Chakravartty, for instance, emphasizes that causal properties confer dispositions for relationships—specifically behavioral dispositions for particular entities with the said properties. From the IBE-C perspective:

(i) The entities and processes with which we interact causally are generally better established than those that figure in theoretical hypotheses (Cartwright 1983).

(ii) The justification for accepting a causal hypothesis comes from concrete facts and low-level laws established over limited regimes. Causal interaction attributions can convince independently of considerations in terms of ordinary epistemic virtues.

(iii) Causal justification is generally more robust than theoretical justification (Suárez 2008). To the extent that this is so, claims with causal backing deserve a more substantial realistic commitment than those with merely theoretical support.

For the above reasons, the IBE-C strategy limits realistic engagement to specific UTE-free material assertions (as opposed to global skeptical UTEs).

IBE-C Thesis: Theory parts with causal justification can be defended against solid versions of the anti-realist critique; those parts form a hard core of realist commitment.

The Primacy of Judgment

The highlighted advances of selectivism seem to improve the scientific realism project significantly. Still, no matter how safe they appear, one can think of empirically equivalent competitors for virtually all substantive hypotheses. Consider, for example, the "brain in a vat" hypothesis given prominence by Hilary Putnam (1981), according to which we are not what we think we are: we are disembodied brains living in vats filled with nutrients and connected to a computer that some external operator handles.

Are we what we ordinarily think we are, or do we live in a simulation? How do you answer such a question? There is no shortage of proposals with similar skeptical force. As Paul Feyerabend pointed out in the 1970s, choosing an answer is not exactly something we can resolve empirically. How are we then to recognize and follow the truth? Encouraging overreaction, Feyerabend (1975b) advised that the idea that we should "follow the truth" is a statement whose truth is nothing but a dogmatic ideology. Whatever one thinks of the latter recommendation, the critical point is that not even the most compelling scientific theories are free from insidious, skeptical UTE charges. The resulting skeptical objections apply to all IBE strategies, including the most substantial forms of IBE-C (Egg 2021). The same applies to selective working-level, functional realist claims and other promising updates to scientific realism.

However, there is one pragmatically rooted response to radical suspicions like those just voiced. It consists of noting that extreme skeptical variants appeal to ways of thinking that question the availability of evidence for more than the specific hypotheses they target. Their corrosive effect blows all empirical knowledge equally. According to scientific realists like Dudley Sapere (1984, 1987), the appropriate response is to reject such skeptical moves outright—we should drop all those hypotheses that result in general skepticism if taken as relevant options. This response appeals to a historically grounded epistemic value:*non-specific doubts (global or metaphysical), far from promoting our epistemic goals, ruin them.* In this pragmatist response, the mere logical possibility of doubting a theory does not constitute a reason to doubt that the theory is correct. It judiciously acknowledges the epistemic value of rejecting global (metaphysical) doubts as reasons for doubting specific claims about the world. In this way, scientific realism frees itself from objections of the UTE-skeptical variety.

Note that the proposed pragmatist turn does not free scientific realism from the need for deliberation. On the contrary, the suggested response places the rational justification of realist commitment explicitly in the realm of judgment. Pragmatist rejection of global doubts rests not on any formal procedure but deliberation. All naturalistic varieties of scientific realism rest irreducibly on deliberation. Admittedly, prioritizing judgment in epistemic assessments problematizes scientific objectivity, raising worries about the proposed realist move. The problematization at play need not be harmful, however. By making the values at stake explicit, deliberation can improve the quality of objectivity in at least two ways. On the one hand, it clarifies the values and rationale behind the competing positions. On the other hand, it links the selection to the long-term results of the competing proposals, especially regarding scientific fertility and intellectual coherence.

In appraising any substantive theory, it is not immediately possible to establish which competing option will, in the long run, suggest more and better explanations of the relevant facts or more fruitful extensions to previously unapproached domains of nature. As Toulmin noted in the 1950s, deliberative thinking of a legal nature is consubstantial with contemporary science. This paper takes Toulmin's proposal to heart. Confronted with a specific situation, scientists deliberate about when to apply and when not to use the maximum potential severity of the evaluative criteria forged by science. This prudence is not an incidental aspect of the scientific evaluation of theories and projects. It is an expression of the central diachronicity of the evaluative process.

References

Boyd, Richard N. (1984): "The Current Status of Scientific Realism." *Scientific Realism* (J. Leplin Ed.). Berkeley: University of California Press: 41–82.

Bricmont, Jean (2016): *Making sense of quantum mechanics*. Switzerland: Springer.

Cartwright, Nancy (1983): *How the Laws of Physics Lie*. Oxford: Clarendon Press.

Callender, Craig (2020): "Can we quarantine the quantum blight?" *Scientific realism and the quantum* (S. French & J. Saatsi, Eds.): 57–77. Oxford: Oxford University Press.

Chakravartty, Anjan (2007): *A Metaphysics for Scientific Realism: Knowing the Unobservable*. New York: Cambridge University Press.

Cordero, Alberto (2001): "Realism and Underdetermination: Some Clues from the Practices-Up." *Philosophy of Science* (68S): 301–12.

Cordero, Alberto (2017): "Retention, Truth-Content and Selective Realism. *Scientific Realism: Objectivity and Truth in Science* (Evandro Agazzi, Ed.). Cham: Springer Nature (2017): 245–256.

Cordero, Alberto (2019): "Introduction: Philosophers Look at Quantum Mechanics." *Philosophers Look at Quantum Mechanics* (A. Cordero, Ed.): 1–16. Springer: Synthese Library.

Egg, Mattias (2012): "Causal Warrant for Realism about Particle Physics." *Journal for General Philosophy of Science*: 259–280.

Egg, Mattias (2021): "Quantum Ontology without Speculation." *European Journal for Philosophy of Science* (11): 1–26

Feyerabend, Paul (1975a): *Against Method*, London: 1975; revised edition, London: Verso, 1988.

Feyerabend, Paul (1975b): "How to Defend Society Against Science", *Radical Philosophy* (11): 3–8.

Hesse, Mary B. (1974): *The Structure of Scientific Inference.* London: Macmillan.

Hesse, Mary B. (1980): *Revolutions and Reconstructions in the Philosophy of Science.* Indiana: Indiana University Press.

Kuhn, Thomas S. (1962/1970): *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press (1970, 2nd edition, with postscript).

Laudan, Larry (1981): "A Confutation of Convergent Realism." *Philosophy of Science* (48): 19–49.

McMullin, Ernan (1983): "Values in Science." *Philosophy of Science Association, PSA* 1982 (volume two); P. D. Asquith and T. Nickles (Eds.): 3–28. East Lansing, MI: Philosophy of Science Association.

McMullin, Ernan (1985): "Galilean Idealizations", *Studies in the History and Philosophy of Science Part A* (Vol. 16): 247–273.

McMullin, Ernan (1989): "The explanation of distant action: historical notes." *Philosophical consequences of quantum theory: reflections on Bell's theorem* (James T. Cushing and E. McMullin, Eds.). Notre Dame, Ind.: University of Notre Dame Press: 290–302.

Putnam, Hilary (1981): *Reason, Truth and History.* Cambridge: Cambridge University Press.

Shapere, Dudley (1984): *Reason and the Search for Knowledge: Investigation in the Philosophy of Science.* Dordrecht: D. Reidel Publishing Company.

Shapere, Dudley (1987): "Method in the Philosophy of Science and Epistemology: How to Inquire about Inquiry and Knowledge." *The Process of Science* (Nersessian, N., Ed.).Dordrechter: Kluwer Academic Publisher.

Suárez, Mauricio (2008): "Experimental realism reconsidered: How inference to the most likely cause might be sound." *Nancy Cartwright's Philosophy of Science* (Hartmann, S., C. Hoefer, and L. Bovens, Eds.). New York: Routledge.

Toulmin, Stephen (1958): *The Uses of Argument.* Cambridge: Cambridge University Press.

Toulmin, Stephen (1972): *Human Understanding.* Oxford: Clarendon Press.

Perspectives in physics

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Abstract. Judgments and perspectives are important in science. Judgments are verdicts shaped by values, and different agents—or communities of agents—may weigh such values differently. This leads to the emergence of distinct perspectives when these communities are faced with similar situations. Recognizing that such differences in perspectives play a crucial role in scientific practice is an important philosophical insight. In this paper, we focus on physics and its philosophy, examining cases where perspectives and the judgments they inform are particularly evident. However, perspectives also play a deeper role. The perspectival nature of meta-level considerations about physics has a counterpart within physics itself: in recent decades, there has been growing recognition that quantum mechanics presents the physical world as fundamentally perspectival.

1 Introduction

In daily life, it is common to encounter differences of opinion—ideas and perspectives can vary significantly between individuals and across social or cultural groups. The situation in natural science, particularly in physics, seems quite different: the same physical theories are accepted worldwide, and the use of these theories leads to predictions that are independent of the physicist who made them or the group to which the physicist belongs. There thus appears to be little room for differing perspectives or opinions in physics.

This view can be upheld to some extent in the case of well-established physical theories whose empirical adequacy has been convincingly demonstrated. Consider, e.g., classical mechanics, electrodynamics, special and general relativity, and quantum mechanics, each within its domain of applicability. These theoretical frameworks are standard predictive tools that have been verified countless times, and their value is universally acknowledged. However, when we shift focus to other aspects of physical practice—aspects that go beyond standard predictions using well-confirmed theories—a different picture emerges. For instance, opinions about promising new research avenues often vary greatly among individual researchers and across different research communities. Even in the case of universally accepted, well-confirmed theories, perspectives can diverge widely on questions beyond empirical adequacy, such as interpretational issues. The debates about the interpretation of quantum mechanics are particularly notorious in this regard, but even in the case of physics theories, there are controversial questions of

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interpretation—e.g., concerning the status of space, time, and force. In such cases, different judgments and perspectives are common.

Judgments are shaped by viewpoints and values, and often lack the form of logically compelling arguments. As a result, different agents or groups may develop differing views when faced with similar situations. The significant role that such judgments and viewpoints play in science is an important philosophical insight. In this paper, we will illustrate the point, focusing on physics and its philosophy. We will briefly discuss several examples in which less-than-logically-compelling judgment is a key factor: perspective-dependent decisions regarding theory choice, judgments about the adequacy of explanations, and judgments concerning the correct interpretation of theoretical frameworks.

Thus, the landscape of physical theorizing and interpretation is not monolithic but rather fragmentized, allowing for a variety of points of view. Interestingly, perspectivalism appears not to be confined to meta-level considerations of physical theories and their interpretation. It seems to have a counterpart in the physical descriptions themselves. Recent foundational studies suggest that the descriptions of physical systems provided by quantum theory are perspectival in the sense that they are defined relative to reference systems. If this is correct, the physical world as described by quantum physics is fragmentized, consisting of many mutually inconsistent perspectival representations.

2 Science, Judgments, and Perspectives

It remains common to encounter the view that science is characterized by a method that allows for the logical proof of laws and theories starting from observational facts. This belief places scientific results in the same category as mathematical theorems. The idea has a long and respectable history, aligning with Aristotle's claim that humans possess a special faculty for grasping the essential nature of natural phenomena, enabling the extraction of fundamental background principles from observation. Once such self-evident axioms are established, more complex laws can be deduced through logical combination and reasoning.

The notion of an Aristotelian infallible "inner eye" was strongly challenged during the Scientific Revolution, yet empiricist ideas emerged to fulfill a similar role. For example, Newton's *Regulae Philosophandi* fostered the impression that induction, combined with careful and repeated observation, leads to indubitable general results. The development of "Inductive Logic" may have further reinforced the perception that induction is on par with systematic deductive reasoning, such as in geometry. Additionally, Kant's argument that certain fundamental aspects of natural science can be estab-

lished *a priori* as necessarily true may have contributed to the idea that a unique scientific method yields certain results.

However, there has also been a long-standing resistance to the notion that scientific discovery follows a strict inductive method. Since the late 19th century, when philosophy of science became a distinct discipline, this opposition has gained prominence. In the 20th century, Karl Popper (1959) introduced his virtually method-free "context of discovery", arguing that justification, in the traditional sense of proof, is impossible. According to Popper, the only strict methodological rule scientists should follow is the principle of falsification—eliminating empirically inadequate hypotheses as swiftly as possible.

Thomas Kuhn (1962) replaced this austere view with a model that more accurately reflects scientific practice and reinstates a role for systematic inductive reasoning. However, Kuhn's methodology does not rely on rigid inductive rules; rather, it involves reasoning based on values that, while generally compelling, may be interpreted differently in concrete cases by different scientific communities. Moreover, tensions can arise between these values when applied to actual research questions, as illustrated below.

Kuhn outlined several key values for evaluating the viability of new theoretical ideas:

Accuracy: Hypotheses should precisely align with observational data.

Consistency: Hypotheses should be internally coherent and should not contradict established background knowledge.

Broadness of Scope: Hypotheses should have wide applicability.

Simplicity: Simpler explanations should be preferred over more complex ones.

Fruitfulness: Theories that lead to correct predictions in new domains should be favored over those that only explain already known phenomena.

These methodological values are general and often open to multiple interpretations. For instance, simplicity is notoriously difficult to define, and disagreements frequently arise over which of two competing hypotheses is simpler. Furthermore, different values can sometimes be in tension. Striving for maximum accuracy, for example, may increase the likelihood of conflicting with existing background knowledge. Likewise, if simplicity is interpreted as avoiding unnecessary theoretical elements, it may conflict with fruitfulness—indeed, historical scientific developments often made use of quantities that were previously not needed. A case in point is classical electrodynamics: while it can make all its empirical predictions using only

the electromagnetic fields $\boldsymbol{E}$ and $\boldsymbol{B}$, the introduction of potentials A and φ—seemingly superfluous—proved crucial for the development of quantum electrodynamics.

The role of values in scientific reasoning has become a central topic in contemporary philosophy of science. A widely discussed issue is the "underdetermination of theories by empirical evidence", where multiple theories or research programs are equally compatible with available data. In such cases, theoretical virtues like simplicity, parsimony, and explanatory power necessarily play a crucial role in assessing their relative merits (Acuña and Dieks 2014). This issue is particularly pressing in modern high-energy physics and cosmology, where limitations to what can be observed pose significant challenges.

Thus, in high-energy physics, advancing empirical research requires probing elementary particles with ever-higher energies. However, the particle accelerators needed for such investigations are becoming impractically large, with breakthrough energy scales soon demanding accelerator sizes exceeding Earth's radius. Similarly, in cosmology, observational limitations arise due to the vastness of the universe and the constraints imposed by the speed of light. Since information cannot travel faster than light, certain parts of our expanding universe are forever beyond our observational horizon. Some philosophers of science even propose that, given these obstacles, modern physics may need to embrace a more rationalist methodology, where theoretical virtues take precedence over empirical data (Dawid 2013).

Judgments that weigh competing values are thus becoming even more central to scientific methodology. While perspectives on the relative importance of these values may be personal, they often align with different sub-communities within the scientific field, leading to diverging opinions on the viability of theoretical frameworks and research directions.

A similar situation arises in the interpretation of scientific theories. The example of the ongoing debates surrounding the interpretation of quantum mechanics provides a good illustration of the broader nature of interpretative disagreements. The fundamental question in interpretative debates is: given the mathematical formalism of a scientific theory and its empirical predictions, what is the most plausible picture of reality—including the unobservable—that accords with the theory?

Generally, multiple answers to this question can be given, depending on how different values—such as visualizability, coherence, simplicity, practical usefulness and consistency with other theories—are prioritized. Moreover, the importance attached to the decision to adopt a realist rather than an instrumentalist stance evidently plays a major role in the ensuing debates.

A brief look at some interpretations of quantum mechanics highlights the significance of these values. The standard (textbook) interpretation, for

example, adopts a pragmatic approach, focusing on predicting the statistical outcomes of macroscopic measurements without delving into the nature of measurement itself. This standard interpretation says that measurements are ruled by a special principle (the "collapse of the wavefunction") that generates a definite measurement result; each possible result having a probability of occurring that can be calculated with the mathematical machinery of quantum mechanics. Although this textbook interpretation usually employs realist terminology (it speaks about atoms, protons, electrons, and so on), it remains vague about the nature and properties of these "quantum systems" outside of measurement contexts.

Alternative interpretations challenge the standard view for its lack of a coherent physical picture that can explain what is going on "behind the scenes of observation". The interpretation proposed by Bohm (1952), for example, seeks to rectify this by postulating that quantum mechanics is a theory about particles in the classical sense, namely visualizable microscopic objects with definite positions and trajectories. In this framework, the mathematics of quantum mechanics is interpreted as a formalism that describes how the "Bohm particles" move. In this scheme there is no special role for measurement: measuring devices consist of quantum particles, which interact with the particles composing the objects on which measurements take place. The outcome of a measurement then corresponds to some ordinary physical quantity, like the position of a pointer on a dial. This property is completely determined by the positions of the particles that together constitute the pointer. So, no special principle is needed to generate a definite measurement outcome.

The Bohm scheme is coherent, visualizable, and empirically adequate, but proves to conflict with the special theory of relativity. It turns out that the existence of a privileged inertial frame of reference must be assumed to make the Bohm scheme consistent, and this is at odds with Einstein's principle that all inertial frames are equivalent. An interpretation that does not face the latter problem is the many-worlds-interpretation (e.g., Wallace 2012): this interpretation does not introduce permanently localized particles (these were responsible for the difficulty with special relativity in the Bohm interpretation). Like the Bohm theory, the many-worlds-interpretation does not invoke a special evolution principle that is solely applicable to measurement: there is no collapse of the wavefunction. But now a new problem arises: the formalism does not predict a definite measurement outcome, since all possible outcomes remain represented in the superposition of the uncollapsed post-measurement wavefunction. The many-worlds-interpretation deals with this situation by assuming that after a successful measurement different worlds exist, each characterized by one particular measurement outcome.

While this interpretation may be argued to remove some *ad hoc* elements, it raises concerns about visualizability (e.g., of the splitting of one world into many worlds), simplicity (more worlds seem to be introduced than what is needed to account for our observations), and coherence (evolution without collapses is deterministic, which seems difficult to square with the probabilistic nature of quantum mechanics). However, many-worlds proponents argue that the simplification due to the elimination of arbitrary postulates is more important. This illustrates our earlier comment on the ambiguity of the notion of simplicity.

The debates on the interpretation of quantum mechanics illustrate that, as with scientific discovery and justification, interpretative frameworks are shaped by values and perspectives. Different scientists and sub-communities may prioritize different theoretical virtues, leading to diverse preferences. The ongoing plurality of interpretations in quantum mechanics underscores that such divergence is not merely a theoretical possibility but a reality in scientific practice.

Diversity of opinions extends to broader epistemological issues. For example, conceptions of what constitutes understanding-providing explanations are non-universal and value-dependent. Are, for instance, simplicity and unificatory power essential for generating understanding, or are causal mechanisms and visualizability indispensable? As de Regt (2017) argues, different scientific sub-communities may employ different sets of conceptual tools to provide explanations and attain understanding in different ways.

Furthermore, even the aims of science are subjects of debate. Should science aim to represent reality as it truly is (the realist position)? Should it be satisfied with empirical adequacy and constructing images of how reality *could* be, as van Fraassen (1980) suggests? Or should science renounce the goal of coherently representing unobservable reality altogether, as instrumentalists propose? Each of these positions can be defended rationally and consistently, based on differing values, perspectives, and judgments.

3 A fragmented world

The scientific community can therefore be seen as a collection of individuals and sub-communities that differ in their values and judgments regarding methodological issues and interpretations. This diversity creates a methodological landscape that is fragmented rather than monolithic. Such a conclusion may be considered hardly surprising—perspectives shape many human activities, so why not even the "hard sciences"? Moreover, science also certainly exhibits a lot of consensus, leading to a body of generally shared empirically adequate and, in this sense, objective and universal theories (leaving aside, for a moment, different "metaphysical" interpretations). So, the perspectivalism that we have discussed may be judged to be non-radical.

Remarkably, however, a much more radical form of fragmentation has been proposed in recent decades—one that applies not to scientific methodology and human preferences, but to physical reality itself. According to this view, the physical world may be objectively perspective-dependent. That is, the properties of physical objects and processes may be inherently relational, defined only in reference to other systems, independent of human judgment.

This notion of a fragmented reality was introduced by philosopher Kit Fine (2005), who suggested it as a way to rethink traditional debates about time and tense. The idea has since been further developed by Lipman (2015, 2016, 2020). The core of fragmentalism is the claim that reality is not a single, unified whole consisting of mutually compatible facts but rather a collection of distinct fragments. Each fragment contains internally consistent facts, yet different fragments may be mutually incompatible. Thus, no single, overarching description of reality is possible; instead, the totality of all fragments is needed for a complete account of the world.

As mentioned, one suggested application of fragmentalism is the nature of time: accordingly, each instant in the history of the universe should be viewed as defining a distinct fragment of the total world, namely the world at that instant. Another possible application is the special theory of relativity, where different reference frames provide equally real but differing accounts of distances, durations, and simultaneity (Lipman 2020). According to the fragmentalist view, these variations are not mere appearances but instead define different, self-consistent fragments of reality.

However, both of these applications face the objection that an alternative, unified description exists. The history of the world can be represented as a four-dimensional "block universe", and relativity naturally describes reality as placed in four-dimensional Minkowski spacetime. In these formulations, all facts are mutually compatible, and perspective-dependent facts can be derived from a single, coherent structure. This weakens the argument for treating fragments as fundamental.

The situation changes, however, when quantum mechanics is considered as a potential application of fragmentalism. An increasingly popular view holds that quantum properties are inherently relational—implying that a system's description should always be relative to another system that serves as a reference system. This idea, and its implications, will be explored in the next two sections.

4 Wigner's friend

The Nobel Prize-winning physicist Eugene Wigner (1961) introduced a thought experiment—now known as the Wigner's Friend scenario—that illustrates the naturalness of perspectivalism in quantum mechanics. In its standard formulation, the experiment involves two agents: Wigner and

his friend. The friend is inside a hermetically sealed laboratory, where she measures a quantum particle, while Wigner remains outside, isolated from the events within. However, Wigner knows the initial quantum state of the laboratory and can use quantum mechanics to predict its evolution. According to standard quantum theory, the state of an isolated system (its wavefunction) evolves deterministically via the Schrödinger equation.

The quantum particle measured by Wigner's friend is in a quantum state in which there are two possible outcomes, o_1 or o_2, each with an associated probability. In more detail, the particle is in a state that is a "superposition", $c_1 |o_1\rangle + c_2 |o_2\rangle$, with c_1 and c_2 numerical coefficients, and $|o_1\rangle$ and $|o_2\rangle$ quantum states in which the first and the second possible outcome, respectively, are certain to be found. Now, textbook quantum mechanics tells us that Wigner's friend, upon performing her measurement, will register either outcome o_1 or outcome o_2, and that the particle's state will accordingly *collapse* either to $|o_1\rangle$ or $o_2\rangle$. After the measurement, Wigner's friend will attribute the value that she has found as a definite property to her particle. For example, if the particle is initially in a superposition of "spin up" and "spin down", the particle has the definite property "spin up" after the measurement outcome "up". This can be empirically verified via follow-up spin measurements: these will all have the outcome "up".

However, Wigner is outside and has not performed a measurement. He must therefore describe everything that went on inside the laboratory by means of the Schrödinger equation, without collapses. This will lead to an "entangled state", namely $c_1 |o_1\rangle |F_1\rangle + c_2 |o_2\rangle |F_2\rangle$ for the combined system of Friend and particle, where $|F_1\rangle$ and $|F_2\rangle$ are states in which the Friend has registered outcome o_1 or o_2, respectively. In this state of Wigner's friend plus particle, both possible outcomes coexist in superposition (the situation is analogous to that of the famous Schrödinger cat paradox, in which there is a superposition of a state according to which the cat lives and a state in which the cat has died). The presence of this entangled state implies that neither the friend nor the particle has a definite property associated with a single outcome. Rather, the states of the friend and the particle are "mixed", containing components of both possibilities. Technically, the states are density operators obtained through "partial tracing", representing *improper* mixtures (as opposed to *proper* mixtures that represent our ignorance about which outcome is actually present).

The important conceptual point is that after the measurement, the external observer describes the particle and the other contents of the laboratory in a way that is inconsistent with how the internal observer describes them. Crucially, the external description in terms of the superposition of the two possible internal outcomes, is not subjective in the sense of being due to a lack of knowledge of what the internal observer found. The external

observer can perform a measurement on the sealed laboratory that verifies the correctness of assigning a superposed state. His description therefore corresponds to a *physical fact*. If the external observer would instead use a description of the laboratory that implies that one of the two results has become definite in the measurement, while adding that he does not know which one has actually been realized, his predictions would be incorrect.

In his original article, Wigner (1961) attempted to remove the apparent conflict between the internal and external descriptions by postulating a special role for *consciousness*: he assumed that a collapse takes place, as an objective physical event, as soon as the first *conscious* observer performs a measurement. On this assumption, the friend's measurement collapses the state also from Wigner's point of view, so that Wigner is forced to abandon the collapse-less Schrödinger equation. Both Wigner and his friend must in this case describe the post-measurement situation with a collapsed state, so that the inconsistency disappears. However, as many commentators have argued, this maneuver replaces the original problem by even deeper problems relating consciousness. What counts as consciousness? How should consciousness interact with the material world?

We mentioned above that the use of a collapsed state by the external observer leads to predictions that are incorrect, and this by itself should of course decide the issue. However, a word of caution is in order here: An experiment with an external observer performing a quantum measurement on a sealed laboratory with a conscious being inside has never been performed. So, the inadequacy of the collapsed state in such cases has not been tested directly. However, experiments with semi-classical objects suggest that there is no limitation to the applicability of the superposition principle, and inductive reasoning on this basis makes the occurrence of collapses unlikely. This, together with the unresolved questions concerning consciousness, make Wigner's solution unattractive.

An alternative resolution, proposed by Ghirardi, Rimini, and Weber (1986), replaces the role of consciousness with spontaneous objective collapses occurring as part of natural physical processes. In their theory, collapses of the wave function occur spontaneously and randomly, with a very small probability at the (sub)microscopic level; but this probability grows with the number of particles involved and becomes virtually 1 in the case of macroscopic systems. In the Wigner's friend case it would accordingly be practically certain that the friend's macroscopic measurement induces a collapse. Wigner's collapse-free calculations with Schrödinger evolution would therefore lead to incorrect results. This GRW theory of objective collapses is different from quantum mechanics, though, since it predicts the near impossibility of macroscopic superpositions. This seems to contradict recent empirical results. As far as present evidence goes, there is no sign

of a failure of the standard quantum mechanical predictions, which allow macroscopic superpositions---even if they are difficult to detect because of so-called decoherence processes. Since no evidence currently supports GRW-like deviations from quantum theory, and since we are interested in the question of how quantum mechanics may describe the physical world, we will not pursue the GRW-approach further.

Another escape route from the inconsistency is to deny the universal validity of quantum mechanics. If quantum mechanics does not apply to macroscopic systems, then Wigner cannot assign a quantum state to the macroscopic laboratory. It sometimes is suggested that the founding fathers of quantum mechanics believed that there exists a dividing line in Nature, on one side of which quantum mechanics is valid, with classical physics obtaining on the other sides. This suggestion is not infrequent in the older literature. However, modern historical scholarship opposes this interpretation of the views of pioneers like Bohr, Heisenberg and von Neumann. These physicists had no qualms about using quantum mechanics for describing the behavior of macroscopic objects. Relevant here is the doctrine of the arbitrariness of the place of the "cut" between classical and quantum descriptions: according to von Neumann (1932) this "cut" can be pushed arbitrarily far into the macroscopic world, a view that was also defended by Heisenberg (Bacciagaluppi and Crull, 2009). Macroscopic devices may therefore certainly be treated quantum mechanically, and there is no boundary to the applicability of quantum theory to the physical world. For a concrete illustration, think of Bohr's (1949) application of Heisenberg's indeterminacy principle to a macroscopic two-slit screen, in his famous discussion with Einstein about quantum interference experiments. The cut that marks the dividing line between descriptions with quantum and classical concepts must be given an epistemic rather than an ontic status (Dieks (2016) provides more details). An important additional consideration, already mentioned several times, is that the assumption that macroscopic systems are fundamentally classical is at odds with present-day experimental physics. So-called Schrödinger cat states, i.e., superpositions of quantum states of quasi-macroscopic systems, are now routinely prepared in the laboratory. Rejecting the universal applicability of quantum theory is thus certainly not an attractive way of escaping Wigner's paradox.

We are left with the original problem posed by Wigner's thought experiment: How can the definite outcome observed within the laboratory be reconciled with the non-definiteness required by an external observer's description?

5 Quantum perspectivalism

A natural conclusion to draw from the paradox of Wigner's friend is that different observers may have different *perspectives*, according to which different quantities possess definite values (Rovelli 1996; Bene and Dieks 2002; Conroy 2012; Dieks 2009, 2019, 2022, 2025). In the concrete case of the Wigner's friend scenario, the experiment in the laboratory has a definite outcome *from the perspective of Wigner's friend*. Moreover, from the friend's perspective, after the measurement the measured particle is characterized by a definite property corresponding to the outcome that was found. By contrast, *from Wigner's perspective* there is no definite result of the experiment. From Wigner's viewpoint the entire lab, including his friend, the particle and the devices used in the experiment, should be described with a superposed quantum state in which all possible outcomes are represented. The properties that Wigner assigns to the laboratory should be in accordance with this superposed state. In technical terms: for Wigner only those physical quantities are definite whose representative operators have the superposed lab state as an eigenstate. This leads to a property attribution that is different from the one applicable to Wigner's friend. The contradiction between internal and external descriptions is thus dissolved: the two descriptions are not absolute but relative to a perspective, and these perspectives are different in the two cases.

So, we arrive at a perspectival interpretation of quantum mechanics, in which the internal perspective in the laboratory differs from the external perspective. This interpretation follows the mathematical structure of no-collapse quantum mechanics (so-called unitary quantum mechanics) in a natural way. Indeed, in the post-measurement state $c_1 |o_1\rangle |F_1\rangle + c_2 |o_2\rangle |F_2\rangle$, the states of Wigner's friend in which she has registered either the outcome o_1 or o_2 are correlated with particle states belonging to exactly that same outcome, and the interpretation says that these "relative particle states" represent her perspective once she has registered one of these outcomes. In contrast, the state of Wigner and the laboratory, before Wigner has made any measurement, can be written as $(c_1 |o_1\rangle |F_1\rangle + c_2 |o_2\rangle |F_2\rangle) |W\rangle$, so that Wigner is correlated with the complete superposed laboratory state. So, reasoning in the same way as in the case of the friend, this superposition is his relative state. It represents his perspective and the physical properties he must attribute to the laboratory and its contents.

In the Wigner's friend scenario two humans make measurements and become aware of outcomes, and for ease of expression we have referred, when talking about the different perspectives, to "points of view". This could create the impression that we are discussing ordinary perspectives or subjective viewpoints, of the kind that occur in daily experience. For example, when we walk around an object, we view that object from different

angles, and these angles correspond to different perspectives in the everyday sense. Perspectival views of this kind, however, can be reduced to absolute ("monadic") properties of the object and the observer, respectively. Indeed, given the position and the dimensions of the object, and the position of the observer, the corresponding perspectival description is completely fixed. So, according to classical physics, perspectives are not fundamental but secondary, in the sense of derivable. Fundamental quantities, by contrast, are monadic, both according to classical physics and everyday experience: they represent properties possessed by an object independently of whether it is observed or not, and independently of the presence of other objects. Paradigmatic quantities of this kind are mass, charge, length, height and width. Relational quantities in classical physics are reducible to monadic properties of this kind; for example, if John is *taller* than Pete, this is due to the fact that John's *length* is greater than Pete's.

The quantum perspectives that we are introducing here are very different: they are not derivable from monadic physical properties. The perspectivalism that we are introducing here does not suppose that the particle in the laboratory of Wigner's friend has well-defined properties in itself from which the two perspectival descriptions can be derived. The opposite is the case: the descriptions are irreducible perspectival, in this case with respect to the observer in question.

So, summing up, according to quantum perspectivalism (Dieks 2022, 2025) properties of quantum systems are not monadic but relational, defined with respect to another system. In order to determine such perspectival properties, one needs to determine the total quantum state involving both the object system and the reference system (as illustrated by the example of Wigner's friend). The perspectival properties are encoded in this total state through the relative states of systems with respect to other systems.

It is important to emphasize that the perspectives, thus defined, are objective and have nothing to do with whether or not conscious observers are present. Therefore, one could reformulate the story of Wigner's friend without referring to Wigner, his friend, or other humans. If Wigner and his friend are replaced by inanimate detection devices, the analysis and its conclusions will not change. In this case the perspectival properties are defined with respect to the detection devices. The above formulas for total states and the relative states derived from them remain the same in this case. But $|F\rangle$ and $|W\rangle$ will now refer to, e.g., detection devices. In general, quantum perspectives can be defined relative to any physical system.

Quantum perspectivalism requires a major revision of our thinking about physical objects. In classical physics, and according to common sense, the physical quantities that characterize an object are determined by the nature of the object itself, independently of observers or contexts. Relational

properties (for example, mutual distance) are derivable from these absolute properties (e.g., relative distances are derivable from absolute positions). It follows that the *values* of classical relational quantities may vary with perspectives, i.e., frames of reference or observers. For example, for a co-moving observer the velocity of an object vanishes, whereas this velocity has a non-zero value for other observers. But it also follows that it will never happen, in classical physics, that for one observer velocity is an applicable notion, while it fails to be so for others. Quantum perspectivalism breaks with this traditional way of conceptualizing objects and their properties. It proposes a quite general perspective-dependence of the applicability of concepts, according to which different quantum perspectives cannot be glued together to form one encompassing consistent picture. Indeed, according to quantum perspectivalism the physical world itself is *fragmented*, consisting of mutually conflicting perspectives.

6 Summary and conclusions

Recent philosophy of science has increasingly recognized the role of value-laden perspectives in various contexts, such as scientific heuristics, the evaluation of new hypotheses, the merits of different types of explanation, and debates on the ontological interpretation of scientific theories. While rational discussion remains possible, values shape the premises of these debates. Differences in the relative importance assigned to such values often lead to multiple, equally respectable perspectives, challenging older views that saw science and scientific progress as governed by a fixed, rigorous method.

Remarkably, a similar shift has emerged within fundamental physics, moving from absolute, monadic descriptions of physical systems to fundamentally relational and perspectival accounts. This perspectivalism aligns well with the mathematical structure of no-collapse quantum mechanics, where the properties of physical systems can be defined relative to other systems (reference systems). According to perspectivalism, instead of asking whether an object possesses a particular property, one must specify a reference system: *Does it have this property with respect to that system?*

According to quantum perspectivalism, different perspectives generally cannot be combined into a single, overarching view. Instead of reconciling them in a classical manner, one must rely on the mathematical formalism of quantum mechanics to assign properties relative to different reference systems—illustrated, for example, by the Wigner's friend paradox. However, while this perspectival incompatibility is revolutionary, it does not eliminate classical notions of objectivity and truth. Within any given perspective, measurement outcomes and descriptions remain objectively valid, accurately reflecting actual states of affairs—though these states of affaires are them-

selves perspective-dependent. So, the for science essential difference between true and false statements remains in place: true statements refer to actual facts, false statements don't. It is correct that facts themselves become perspectival, but this does not entail a breakdown of realism or objectivity.

Within each perspective a consistent picture of the world can be presented. By contrast, facts from different perspectives will often be incompatible with each other, so that the total world is fragmented, in the sense of fragmentalism. Nevertheless, there exists a certain order governing these fragments, which is encoded in the total quantum state. This peculiar combination of a fragmented collection of facts and an overarching abstract principle deserves further analysis.

References

Acuña, P. and Dieks, D. (2014) "Another look at empirical equivalence and underdetermination of theory choice", *European Journal for Philosophy of Science*, 4:153–180.

Bacciagaluppi, G. and Crull, E. (2009) "Heisenberg (and Schrödinger, and Pauli) on hidden variables", *Studies in History and Philosophy of Modern Physics*, 40: 374–382.

Bene, G. and Dieks, D. (2002) "A perspectival version of the modal interpretation of quantum mechanics and the origin of macroscopic behavior", *Foundations of Physics*, 32: 645–671.

Bohm, D. (1952) "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables", *Physical Review*, 85: 166–193.

Conroy, C. (2012) "The relative facts interpretation and Everett's note added in proof", *Studies in History and Philosophy of Modern Physics*, 43: 112–120.

Dawid, R. (2013) *String Theory and the Scientific Method*. Cambridge: Cambridge University Press.

De Regt, H. (2017) *Understanding Scientific Understanding*. Oxford: Oxford University Press.

Dieks, D. (2009) "Objectivity in perspective: Relationism in the interpretation of quantum mechanics", *Foundations of Physics*, 39: 760–775.

Dieks, D. (2016) "Niels Bohr and the formalism of quantum mechanics", in Faye, J. and Folse, H. J., eds., *Niels Bohr and the Philosophy of Physics; Twenty-First-Century Perspectives*. London: Bloomsbury Academic, 303–334.

Dieks, D. (2019) "Quantum Mechanics and Perspectivalism", in Lombardi, O., Fortin, S., López, C. and Holik, F., eds., *Quantum Worlds. Perspectives on the Ontology of Quantum Mechanics*. Cambridge: Cambridge University Press, 51–70.

Dieks, D. (2022) "Perspectival Quantum Realism", *Foundations of Physics,* 52: 95.

Dieks, D. (2025) "Radical Perspectivalism, Locality and Relativity", *Foundations of Physics*, 55:30.

Fine, K. (2005) "Tense and Reality", in *Modality and Tense: Philosophical Papers*. Oxford: Oxford University Press, 261–320.

Ghirardi, G. C., Rimini, A. and Weber, T. (1986). "Unified dynamics for microscopic and macroscopic systems", *Physical Review D*, 34: 470–491.

Kuhn, T. (1962) *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Lipman, M. A. (2015) "On Fine's fragmentalism", *Philosophical Studies*, 172: 3119–3133.

Lipman, M. A. (2016) "Perspectival Variance and Worldly Fragmentation", *Australasian Journal of Philosophy*, 94: 42–57.

Lipman, M. A. (2020) "On the fragmentalist interpretation of special relativity", *Philosophical Studies* 177: 21–37.

Popper, K. (1959) *The Logic of Scientific Discovery*. London: Hutchinson & Co.

Rovelli, C. (1996) "Relational Quantum Mechanics", *International Journal of Theoretical Physics*, 35: 1637–1678.

van Fraassen, B. (1980) *The Scientific Image*. Oxford: Oxford University Press.

von Neumann, J. (1932) *Mathematische Grundlagen der Quantentheorie*. Berlin: Springer. English translation (1955): *Mathematical Foundations of Quantum Mechanics*. Princeton: Princeton University Press.

Wallace, D. (2012) *The Emergent Multiverse*. Oxford: Oxford University Press.

Wigner, E. (1961) "Remarks on the mind–body problem", in Good, I. J., ed., *The scientist speculates*. New York: Basic Books, 284–302.

Judgement in hermeneutics

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Hermeneutics[1] is a methodological approach used mainly in the humanities but also used in law and medicine. It is a theory of understanding, mainly of texts, but also of other representational forms of reality. In concentrating on "understanding", hermeneutics sometimes is seen as distinguished from "explaining". So, hermeneutics is directed to the methodological understanding of the representation of material and immaterial, visible and invisible realities in texts, symbols, art, models, etc., in which these realities and the knowledge and understandings of them are expressed by human beings. In a sense, hermeneutics is also about understanding the human being, who in various forms expresses its world.

To see what hermeneutics is about, it is helpful to remember the origin of the term "hermeneutic" in Greek (ἑρμενευτική). As far as we know, this term was first used by Plato. According to the most ancient sources, hermeneutic means the interpretation of the signs of the gods—rather like the interpretation of dreams. Interpretation here is used in the twofold sense of "translating" and "giving meaning" to signs from elsewhere. In European philosophy, from Plato to Martin Heidegger, the origin of hermeneutic was connected with the god "Hermes".[2] Hermes's role was to interpret divine messages to human beings.[3] In later Greek antiquity, the god Hermes was seen as the mediator *per se*, as magician and the inventor of language and scripture. All this shows that hermeneutics is seen as interpretation in the strict sense (as translating) and in a figurative sense. In the later history of hermeneutics, we find these two sides, especially in Friedrich Schleiermacher's hermeneutics at the beginning of the nineteenth century. According to Schleiermacher, in understanding texts we have on the one hand a grammatical analysis and on the other a divination, a prophetic reconstruction of a given text or speech by the reader and interpreter.[4]

[1]This article is in most of its parts an English version of a text, which I have published in German; cf. Hans-Peter Grosshans, Das Hauptproblem der Hermeneutik—ausgehend von Paul Ricoeur, in: Hermeneutische Relevanz der Urteilskraft—Relevance of Hermeneutical Judgement, ed. by Jure Zovko, Wien/Zürich 2021, 35–51.

[2]Despite the similarity of the words this is etymologically questionable.

[3]According Plato, Hermes especially had the competence of speech (περὶ λόγου δύναμις, Platon, Kratylos 408 a2).

[4]Friedrich Schleiermacher,*Hermeneutics and Criticism and Other Writings*, transl. Andrew Bowie (Cambridge: Cambridge University Press, 1998); Jean Grondin, *Introduction to Philosophical Hermeneutics* (New Haven/London: Yale University Press, 1994).

The Relevance of Judgment for Philosophy of Science, edited by Jure Zovko.
Comptes Rendus de l'Académie Internationale de Philosophie des Sciences 4 (2025).
H.-P. Grosshans, Judgement in hermeneutics, pp. 77–87.

The high emphasis on hermeneutics in recent decades was largely inspired by Martin Heidegger's philosophy, by the philosophy of Hans-Georg Gadamer, and generally by the antimetaphysical remodelling of philosophy and the humanities and the establishment of a new way of thinking, a post-metaphysical thinking—as Jürgen Habermas called it—, which also was not only simple empiricism. So, hermeneutics became the main scientific approach in the humanities and beyond in the attempts to dissolve metaphysical orders and metaphysical realism into processes of interpretation. We find this approach—even under different names—among French phenomenologists, German idealists and American neo-pragmatists (like Richard Rorty).

Today the hermeneutical approach is also used in intercultural comparative studies as the signs (in its various forms) from foreign cultures seem also to come from elsewhere. To come to real and adequate understandings of foreign cultures, a reflected hermeneutic is essential.

This chapter shows, in what sense "judgement" is necessary in hermeneutics. This is not immediately self-evident. Someone may say that in understanding a text, for example, it is only necessary to read and then understand. Although in a text many judgements may be included about the subject of the text, it may seem, that in reading and understanding no specific judgement is necessary. Moreover, it may seem one only needs to grasp the judgements of the author. This paper shows, however, that this is an inadequate understanding of reading and understanding, which leads to serious misunderstandings and conflicts.

I.

What is meant by "judgement" or "the power of judgement"? Philosophers tend to refer here to Immanuel Kant's philosophically dominant understanding of judgement as he developed mainly in his "Critique of Judgment" from 1790. Kant distinguished logical, moral, and aesthetic judgement: In a logical, determining judgement, a particular (an intuited phenomenon) is subsumed under a given universal (concept); an aesthetic, reflective judgement involves the quest of a universal to reach a given particular; in a moral judgement, actions are subsumed under principles or laws.[5]

In recent decades, the concept of judgement has undergone an extended change in usage beyond Kant's analysis. An example of this can be found in Hans-Georg Gadamer's "Truth and Method", in which the power of judgement is presented from the outset as one of four humanistic guiding concepts in respect to uncovering the question of truth in the experience of art.

[5]Birgit Recki, Urteil: I. Philosophisch, RGG^4, Vol. 8, Tübingen 2005, 848f.

On the one hand, Gadamer draws on pre-Kantian understandings of the power of judgement, in which it is closely related to the concept of *sensus communis* (common sense). The *sensus communis* admittedly also subsumes a particular under a general, such as under a rule; thus, to a certain extent, it carries out a judgement without reflection. In aesthetics, however, the conditions are reversed for the power of judgement, as Gadamer explains in view of Alexander Gottlieb Baumgarten, who stated: "What the power of judgement recognizes is the sensuous-individual, the individual thing, and what it judges in the individual thing is its perfection or imperfection. Now, in this determination of judgement, it must be noted that here a given concept of the thing is not simply applied, but that the sensuous-individual in itself comes to be apprehended by noticing in it the correspondence of many to one. Here, then, what is decisive is not application of a general, but inner agreement."[6]

In Gadamer's understanding, this is the same as what Kant called an aesthetic judgement. Such a sensuous judgement of perfection is then called "taste".[7] "Taste" contains a critical discrimination and, to an extent, a mode of cognition. According to Gadamer, taste "belongs to the realm of that which, in the manner of reflective power of judgement, grasps in the individual the general to which it is to be subsumed. Taste as well as judgement are judgements of the individual with regard to a whole, whether it fits together with everything else, that is, whether it is 'fitting'."[8] In this sense, taste and judgement are required in all parts of life.

Gadamer brings this power of judgement together with hermeneutics in relation to jurisprudence: "We know this function of judgement especially from jurisprudence, where the law-supplementing performance of 'hermeneutics' consists precisely in bringing about the concretion of law."[9] Gadamer points out that this always involves "more than the right application of general principles ... Always, too, our knowledge of law and custom is supplemented, indeed downright productively determined, by the individual case."[10] In the hermeneutics of jurisprudence, an (aesthetic or hermeneutic) power of judgement is required in the context of the general (legal text) and the particular (the concrete case), through which the two are related not only to each other, but also to the matter of law and custom.

Now, hermeneutics is admittedly first and foremost not a theory of judgement, but above all a theory of the *interpretation of* written and oral texts, in addition to the interpretation of symbols, images or signs in general.

[6] Hans-Georg Gadamer, Wahrheit und Methode. Grundzüge einer philosophischen Hermeneutik, Tübingen [5]1986, 36f. (translation of Gadamer quotes by HPG).

[7] Ibid., 37.

[8] Ibid., 43.

[9] Ibid., 44.

[10] Ibid., 44.

It is also more comprehensive than a mere analysis of texts (among other things), as it happens, for example, in theology in the historical-critical exegesis of biblical texts (and in a similar way in other sciences with other texts). This "more" or "different" than exegesis (and philology), and to that extent also the particular power of judgement is required in hermeneutics, comes into view when we reflect on the main problem of hermeneutics.

II.

The history of modern hermeneutics begins, according Hans-Georg Gadamer, with the Croatian scholar Matthias Flacius from Istria, who published two extensive volumes entitled "Key to Holy Scripture" (*Clavis Scripturae Sacrae*) in 1567, which was a hermeneutic for the methodological interpretation of the texts of the Bible.

Flacius' hermeneutics was modern in his time, that he took the Bible in its material form—i.e., as a text—absolutely serious and removed any form of spiritual interpretation. Therefore, he outlined detailed rules for all available methods and rules of the interpretation of texts—according to the "state of the art" of his time. For Flacius, a kind of freehand interpretation of a spiritual meaning of the text was not adequate for this textual medium of God's self-communication. Therefore, the focus in the methodology of the interpretation of the Bible was on the text as text. Here two principles became important for Flacius: the coherence of a text in the interplay of parts and whole[11], and the identification of the *scopus* of a text, that is, the central theme of the text. The Bible in all its parts has to be understood from the subject it is about in the whole. This can of course only be defined from the text itself, so that we could speak here of a further hermeneutical circle—in addition to that of part and whole of a text—the one between the text and its matter. Now, for Flacius, the overall subject matter of the Bible, the *scopus* and object of the whole Bible, was Jesus Christ[12] or the dialectics of law and gospel, which for Flacius was equivalent with Jesus Christ. Following Martin Luther, Flacius believed that the right handling of this difference must influence not only theological discernment, but also the correct interpretation of Scripture. One could say that the handling of the difference between law and gospel in the interpretation of biblical texts requires a special hermeneutical power of judgement. Doing so requires the specific reference point for judgement of a particular individual text of Scripture to the general dogmatic rule of the distinction between law and gospel.

[11] In a fine essay Jure Zovko has drawn a line from Flacius to new theories of coherence (e.g., that of Nicholas Rescher); cf. Jure Zovko, Die Bibelinterpretation bei Flacius (1520–1575) und ihre Bedeutung für die moderne Hermeneutik, ThLZ 132 (2007), 1169–1180.

[12] Cf. Karl Adolf von Schwartz, Die theologische Hermeneutik des Matthias Flacius Illyricus, Munich 1933, 16.

III.

A very different direction of hermeneutics we find at the beginning of the 19th century in the hermeneutics of Friedrich Schleiermacher. The discussion in his time was about the interpretation and understanding of ancient texts in foreign languages and from foreign cultures. Friedrich Schleiermacher considered the methodology of textual analysis with all the philological knowledge and analytical rules to be too formal for many texts. According to Schleiermacher, we may not come to a true understanding of a text or writing by following the rules of textual analysis alone. Therefore, we cannot only look at the literal reality but have to consider the author and the interpreter as well. The formal, grammatical and historical interpretation needs to be supplemented by—as Schleiermacher calls it—a psychological interpretation. One has to understand a text as a moment in the life of a precise person (the author) or a group of people (to which the author belongs). To understand this, one needs a subjective interpretation rather than an objective interpretation, in which the interpreter has to reproduce the original production of the text. The interpreter has to anticipate, in a kind of inner imagination, the production of the author. For this reproduction of the textual production of an author, the interpreter has to make judgements in which one's understandings of general situations of human existence are applied to specific contextual conditions of the author. As such judgements are very individualized and not based on general rules, they result in the power of judgement of the individual interpreter.

IV.

In 1950, in explicit contrast to the subjective components of understanding, Rudolf Bultmann analyzed what he called the "Problem of Hermeneutics". Against a subjectivist imagination by the interpreter of the production of a text in an author, as Friedrich Schleiermacher in particular had emphasized, Bultmann emphasized the object (the subject matter) that is of interest in the respective process of understanding. An interpretation is, according Bultmann, "always *oriented to a certain question, to a certain wherefore.* But this includes ... that it is always guided by a prior understanding of the object according to which it questions the text."[13]

The object to be understood in the interpretation of a text depends decisively on the questions asked of the text by the reader and interpreter. For example, an instruction manual for a washing machine can be questioned as to how a washing machine can be put into operation; however, it can also be questioned as to what attitude towards life of people in modern times

[13]Rudolf Bultmann, Das Problem der Hermeneutik (1950), in: R. Bultmann, Glauben und Verstehen. Gesammelte Aufsätze, vol. 2, Tübingen 51968, 211–235, 216 (translation of Bultmann quotes by HPG).

is articulated in this text. According to Wilhelm Dilthey, "all texts can be understood as documents of historical-personal life"[14], even if they mainly express something quite different. However, according to Bultmann, in order to explore and understand a certain subject matter in the interpretation of a text, a life-relationship of the interpreter to the subject matter that is directly or indirectly expressed in the text is required as a prerequisite.[15] A factual reference is already required in order to better understand the matter in question by interpreting texts: "The interest in the matter motivates the interpretation and gives it *the question*, its *whereto*."[16] Here, according to Bultmann, it is important that such factual interpretation can only occur in communication with the texts (and also their authors). Thus, with regard to the understanding of philosophical texts, Bultmann can say: "The interpretation of *philosophical texts,* if it is to be a genuinely understanding one, must therefore itself be moved by the question of truth, i.e., it can only proceed in discussion with the author. Plato is understood only by those who philosophize with him."[17] Interpreter and author must refer to the same subject matter and must share the same intellectual practice.

For Bultmann in all texts, but especially in poetry and art and in the works of philosophy and religion, the "*question of understanding singular historical Dasein (existence)*" is at hand, and in this respect, it is a matter of "revealing revealed *possibilities of human existence*" in poetry and art, in philosophy and religion.[18] Then "genuine understanding is not aiming at the contemplation of an alien individuality as such", "but basically at the possibilities of human existence that reveal themselves in it, which are also those of the one who understands, who brings them to consciousness precisely in understanding. Genuine understanding, then, would be *listening to the question posed in the work to be interpreted, to the claim encountered in the work,* and the 'completion' of one's own individuality would consist in the richer and deeper opening up of one's own possibilities, in being called away from oneself (i.e., from one's unfinished, inert self, always in danger of persistence) by the work."[19]

If an interpretation proceeds in this way, then according to Bultmann the "'most subjective' interpretation ... can be the 'most objective'", "i.e. only the one moved by the question of his own existence is able to hear the claim of the text".[20] Here we can see, that for a successful interpretation of texts, which are about human existence, it is necessary, that the interpreter—like

[14]Ibid., 216.
[15]Cf. ibid., 217.
[16]Ibid., 219.
[17]Ibid., 222.
[18]Ibid., 224.
[19]Ibid., 226.
[20]Ibid., 230.

the author—share their reference to the subject matter in question (human existence).

Here also judgement is required: in connecting a general (human existence) with a particular (my existence), or, in connecting a particular (my existence) with another particular (existence of somebody else), which is even more challenging.

V.

In an essay from 1972 on "Metaphor and the Central Problem of Hermeneutics: La métaphore et le problème central de l'herméneutique",[21] Paul Ricoeur tried to identify the main problem of hermeneutics.

For some of the members of the *Académie Internationale de Philosophie des Sciences* (AIPS), who develop their approaches to philosophy of science not in the humanities, but related to other fields of science, it may be of interest to hear, that with his reflections on "metaphors" Ricoeur tried to overcome the opposition of interpretation to explanation, which was emphasised especially in 19th century hermeneutics. According to the Schleiermacherian and Diltheyian tradition, "interpretation has special subjective connotations such as the involvement of the reader in the process of understanding and the reciprocity between textual interpretation and self-interpretation".[22] Explanation, in contrast, is characterized by a kind of objectivity—in the sense of explaining objects—and dispenses with the involvement of the interpreter and knower.

Ricoeur considers a metaphor as a "miniature work" (111). Now, the metaphorical meaning of a word cannot be found in the lexicon, but has to reconstructed in the context of its use. A Metaphor is a contextual change of meaning. It is opposed in particular contexts to other expressions understood literally (in terms of their lexical meaning).

In analysing a metaphor, we can find an explanation for all texts. Understanding metaphors always has two levels: first, "the immanent intention of the discourse",[23] its sense; and second, "the intentional orientation towards a world and the reflexive orientation towards a self"—the reference of texts and words in two ways. In this respect, sense and reference are two aspects of the meaning of a metaphor or a text. A metaphor can neither be understood

[21] Paul Ricoeur, La métaphore et le problème central de l'herméneutique, in: Revue Philosophique de Louvain, 70 (1972), 93–112; here I use as reference for English quotations the German translation of this text (in my translation): Paul Ricoeur, Die Metapher und das Hauptproblem der Hermeneutik, in: Paul Ricoeur, Vom Text zur Person. Hermeneutische Aufsätze (1970–1999), transl. and ed. by P. Welsen, Hamburg (Meiner) 2005, PhB 570, 109–134.

[22] Ibid., 109f.

[23] Ibid., 118.

or explained only on the text immanent level of sense, but only in taking into account "the level of the work's reference to a world and a self".[24]

The main difficulty in explaining metaphor is "to *identify a meaning that* is a *new meaning*".[25] In doing so, the explanation of metaphor must come from its context. The lingual context of a metaphor is the sentence, to which a meaning is to be given. Now, in the case of metaphor, the meaning of the words used in it does not depend only on semantic and syntactic rules—as in their literal use. Here other rules apply, which are nevertheless followed by a linguistic community.

Max Black has called these the "system of associated commonplaces". Thus, in the metaphor "Man is a wolf" the main object is characterized by one of the features of animal life that belong to the "wolf system of associated commonplaces". Here, the metaphor is more than a substitution of a literal expression by a quasi-authentic expression. Given such an interaction, metaphor is translated into direct speech, cognitive content is lost.[26]

Therefore, according to Ricoeur, it is rather necessary for an explanation of metaphor to take into account the "process of interaction" "in order to explain the appearance of new metaphors in new contexts"[27]—or, to put it differently, to consider not only semantics and syntax, but above all the pragmatics of speech. Especially in the case of logically absurd metaphors often encountered in poetry, there is no other way of explanation at all than to give meaning to the expression or to such a sentence. But from where do we derive this new meaning?

According to Ricoeur, it is a fundamental mistake to try to determine this meaning by transferring it from somewhere else, because we would then still be attaching "the creative process of metaphor to a non-creative aspect of language".[28] Metaphors, after all, do not actualize a potential connotation of an expression—one that is, as it were, largely ignored—"but establish it as the main meaning".[29]

Now, when we speak of properties of objects that have not previously had a designation, this implies that the new meaning, at least in language, "comes from nowhere". "To say that a new metaphor comes from nowhere is to recognize it for what it is, a momentary creation of language, a semantic

[24]Ibid., 119.
[25]Ibid., 119.
[26]Quotations from Max Black according to Ricoeur, ibid., 119. Cf. Max Black, Models and Metaphors, Ithaca 1962, 46.
[27]Paul Ricoeur, Die Metapher, 121.
[28]Ibid., 122.
[29]Ibid., 122. Ricoeur here follows Monroe Beardsley, The Metaphorical Twist, in Philosophy and Phenomenological Research, 22 (1962), 302.

innovation that has no already established status in language, either as a designation or as a connotation".[30]

If this is to be a meaning that can be identified again and again, then to do so one must "take the standpoint of the listener or reader and treat the newness of an emergent meaning as the counterpart, located on the author's side, of a construction on the reader's side".[31] And then "the process of explanation is the only access to the process of creation".[32] The "crucial point of explanation is that of constructing the network of interactions that makes of this context a real and unique one".[33] The reality and uniqueness of the context is expressed in "the semantic event" in which a metaphor is created or all words used together acquire new meaning.

Herein lies Ricoeur's actual setting apart from subject-oriented hermeneutics, such as that of Schleiermacher or Diltheys (or Gadamers). Schleiermacher's hermeneutics[34] is also about a construction by the reader or listener in the process of interpretation, but in the form of a re-construction of the author's process of production. In Schleiermacher's two-part interpretive process, a speech "is to be understood as taken out of language, and ... as a fact in the thinker".[35] Accordingly, an interpretation consists of a grammatical interpretation and a psychological interpretation. The successful art of interpretation is therefore based, according to Schleiermacher, "on the talent of language and the talent of the individual knowledge of human nature"[36] in its diversity. The subjective historical reconstruction of a speech or a text thereby means "knowing how the speech is given as a fact in the mind, *subjective divinatory* means anticipating how the thoughts contained in it will continue to have an effect in the speaker and on him."[37]

According to Ricoeur, authorial intent is of no interest at all in the reader's and interpreter's construction of the meaning of an expression or a text. Like a piece of music, a text is for Ricoeur "an autonomous space of meaning which the intention of its author no longer animates".[38] What is written is at the mercy of the reader's interpretation alone.

The interpreter's construction of the meaning of a text then is risky and, according to Ricoeur, resembles a methodological validation of a wager that

[30]Ibid., 122.
[31]Ibid., 122f.
[32]Ibid., 123.
[33]Ibid., 123.
[34]Cf. Paul Ricoeur, La tâche de l'herméneutique: en venant de Schleiermacher et de Dilthey, in: Paul Ricoeur, Du texte à l'action, Paris 1986, 75–100.
[35]Friedrich Schleiermacher, Hermeneutics and Criticism, ed. by Manfred Frank, Frankfurt 1977, 77 (§ 5). On Schleiermacher's hermeneutics: Jean Grondin, Einführung in die philosophische Hermeneutik, Darmstadt ^{3}2012.
[36]Ibid., 81.
[37]Ibid., 94.
[38]Paul Ricoeur, Die Metapher, 123.

we have made. Accordingly, in such an interpreter's construction of meaning, the interpretation of a text can only be about probability and not about certainty: one interpretation is methodically proven to be more probable than another.

So, provided the insights gleaned from metaphor, a text can be explained as a lingual unity with all analytical means of the state of the art of textual analysis (as actually already Matthias Flacius proposed): explaining its meaning, the "what" of the discourse that the text presents. However, given the metaphorical insights, this explanation does not mean that the metaphor and the text has been interpreted. For this, the "what about" of the discourse must be taken into account, i.e., its reference. The reference of a discourse or a text or work is twofold: reference to something and self-reference.

According to pragmatist accounts of realism, reference can be guided criteriologically, but it can never be safeguarded. In real discursive situations, reference is usually unproblematic. Reference is ostensive: we can virtually point to what we are talking about. In written texts, especially complex ones, like metaphors, this is different. They too are about *something*. They are "about a world", "which is the world of this work". "Just as the text liberates its meaning from the tutelage of mental intention, so it detaches its reference from the limits of ostensive reference",[39] and so also from the situation or concrete environment in which the ostensive reference functions. The "world" is then "the totality of references opened up by the text".[40]

To use the context of the AIPS meeting, at which this text was presented, as an example: If we talk about the "Mediterranean world", this metaphor is not understood if we refer only to the sea out there and the wonderful wine we drink on its shores, but this formulation denotes the cross-situational references and the possible symbolic dimensions of our specific overall being-in-the-world. When being-in-the-Mediterranean-world is addressed, the reference is not to something hidden behind the text or in the text, but to something "that is discovered and open". Such "something" gives itself to be understood in interacting with this world. "Texts speak of possible worlds and of possible ways of orienting oneself in these worlds".[41]

Understanding means "following the dynamics of the work, its movement from what it says to what about it says something".[42] The understanding person, in a sense, offers oneself to the possible way of being-in-the-world that the text opens up and discovers for the person.

Methodologically, then hermeneutics is not about the reciprocal relation of two subjects (the reader and the author). So, what is appropriated in the

[39]Ibid., 127.
[40]Ibid., 127.
[41]Ibid., 127
[42]Ibid., 128.

understanding of a text is not the disclosure or reconstruction of an alien experience or intention, but in a very different orientation, "the horizon of a world to which a work is directed".[43] Understanding is not about a fusion of consciousness, empathy or sympathy—and thus not about the recognition of another person—but about the world that is being addressed.

If the understanding of what a text refers to is about discovery and opening up, then the interpreter (and reader) is led away from one's own subjectivity. For Ricoeur, then, to understand oneself in this interpretive process is to understand oneself in the *face of the world of the text.* Thus, through the work and its world, the horizon of understanding that a person gains of oneself also expands.

The hermeneutic circle has to be shifted from a subjectivist level to an ontological one: "The circle exists between my way of being—beyond the knowledge I can have of it—and the way that is opened up and discovered by the text as the world of the work".[44] In interpretation, new ways of being or new forms of life are discovered (to which a text refers; that is, which are already present).

Once again this can be illustrated with metaphors and other figurative means of language, which all belong to the techniques of discourse. Aristotle already articulated this in his *Poetics.* A tragedy tells a story, a myth. Its reference, however, is to be distinguished from it. A tragedy seeks to imitate human actions in a poetic way. Thus, it expresses a world of human actions that is already there (to express the tragedy of life). However, this *mimesis* is not merely to duplicate reality. It is at the same time *poiesis*: construction and creation through which human actions and ways of being appear better and more significant (or comic) than they are in reality. Metaphors originate in this context of poetry: they serve *poiesis in mimesis.* But for Ricoeur, drawing new meanings from our language only makes sense if we have something new to say and a new world to project: "Language creations would have no meaning if they did not serve the general purpose of giving rise to new worlds through the grace of poetry".[45]

When a theory of interpretation such as Ricoeur's places the accent on "opening up a world", both with regard to the emergence of metaphors and with regard to the interpretation of texts, then the subject of "imagination" comes into view, and not only in the gaining of images from our sensory experience, but precisely with regard to ideas of possibilities of being-in-the-world. Then, however, in every interpretation, a hermeneutic power of judgement is also necessary, with which a particular text—even if it is only a small text—is set in relation to the general of being-in-the-world.

[43] Ibid., 129.
[44] Ibid., 130.
[45] Ibid., 133.

Axiomatic thinking and judgment

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Considering the *Relevance of Judgment for Philosophy of Science*, the motto of the AIPS conference 2021, we first ask what the term *judgment* means.

The Merriam-Webster dictionary offers the options given in Figure 1.

1. a : the process of forming an opinion or evaluation by discerning and comparing
   b : an opinion or estimate so formed
2. a : the capacity for judging : DISCERNMENT
   b : the exercise of this capacity
3. a : a formal utterance of an authoritative opinion
   b : an opinion so pronounced
4. a : a formal decision given by a court
   b (1) : an obligation (such as a debt) created by the decree of a court
   (2) : a certificate evidencing such a decree
5. a *capitalized* : the final judging of humankind by God
   b : a divine sentence or decision
   specifically : a calamity held to be sent by God
6. : a proposition stating something believed or asserted

FIGURE 1. From the website merriam-webster.com, accessed in March 2025.

In philosophy of science, we would like to exclude the *authoritative opinion* and the *divine sentence* as meanings, but the word *judgment* may have any of the other meanings mentioned. In jurisprudence, a judgment delivered by a court should be an *informed decision*. This means it must be justified, and every court has to provide a justification for its decision. In this context, the judgment is not to be confused with the justification; however, every such judgment requires a justification as a basis.

Even if "a proposition [is] stating something believed or asserted", we should have the right to ask: *Why?* The answer should, then, document both the process and the capacity for discernment.

In mathematics, we clearly understand how to answer Why-questions: by providing a proof. A proof establishes the truth of a proposition. This

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Comptes Rendus de l'Académie Internationale de Philosophie des Sciences 4 (2025).
R. Kahle, Axiomatic thinking and judgment, pp. 89–95.

fact itself is a judgment—this is symbolically expressed by what Frege called *judgment stroke* (*Urteilsstrich*).[1]

This is also the way that Per Martin-Löf introduced the notion of judgment in his logical framework:[2] "First of all, we have the notion of proposition. Second, we have the notion of truth of a proposition. Third, combining these two, we arrive at the notion of assertion or judgement.", illustrated by Figure 2 [ML87, p. 409].

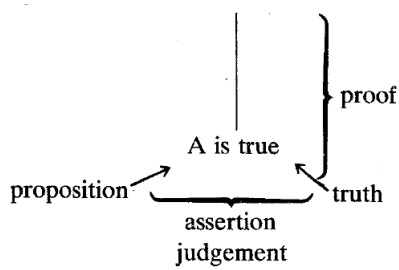

FIGURE 2. Illustration of "propostion", "proof", "truth" and "assertion or judgement" by Martin-Löf.

A proof requires an axiomatic setting.[3] And by use of a proper axiomatization of the fundamental terms of any science—a *framework of concepts* as Hilbert [Hil18] called it—, we can apply our notion of proof, first developed for mathematics only, to other scientific areas. Hilbert, in fact, advocated the application of the axiomatic method to every mature science: "I believe:

[1]Smith [Smi00] discusses at length an apparent "tension" in Frege's conception of the judgment stroke, which seems to maintain a psychological component in his logic. The paper provides a good review of the contemporary and later criticism of Frege concerning this tension and offers a solution by distinguishing "Frege's conception of logic and our own". We don't see any tension at all, if one distinguishes proofs as part of epistemology and truth as part of ontology. But it's worth noting that Frege himself did not make this distinction.

[2]Martin-Löf also gives an interesting historical answer to the question "How did 'judgement' come to be a term of logic?", see [ML11].

[3]Of course, a proof in the colloquial sense will essentially always be informal. But—that is the first lesson of Hilbert's programme—any informal proof should be translatable into a formal proof. This was explicitly acknowledged by Kurt Gödel [Gö95, p. 45]:

> The problem of giving a foundation for mathematics ... can be considered as falling into two parts. At first these methods of proof have to be reduced to a minimum number of axioms and primitive rules of inference ...; and then secondly a justification in some sense or other has to be sought for these axioms ....
>
> The first part of the problem has been solved in a perfectly satisfactory way, the solution consisting in the so-called "formalization" of mathematics ....

everything that can be object of scientific thinking in general, as soon as it is ripe for formation of a theory, runs into the axiomatic method and thereby indirectly to mathematics." This was not empty propaganda, as Richard Courant reminds us [Cou81]:

> At that time Max Born und Franck had come to Göttingen and Hilbert founded a special seminar with the physicists on the Structure of Matter. The term "structure of matter" really comes from Hilbert's seminar. ... The seminar and Hilbert's inspiring interest played a very much greater role in this than the normal art-historical physicist of today knows, or even has the slightest idea about.

Ultimately, the concept of judgment transfers from logic to all other scientific areas which are axiomatized.

There is, however, a catch here. There might be everything correct with a judgment given by a proper derivation of a proposition from certain axioms. But how do we *judge* axioms?

Traditionally they were considered as *evident truths*. But, especially in mathematics, that would today amount to "an authoritative opinion"—as exemplified by the famous *parallel axiom*. The very possibility of non-Euclidean geometries taught mathematics that axioms cannot be taken for granted—despite the acknowledged authority of Euclid.

In fact, modern mathematics dispenses with the notion of absolute truth. Instead, it investigates different *structures*[4] using a unified methodology. This is evident for abstract algebra,[5] but also applies to arithmetic and geometry. For geometry, we already mentioned non-Euclidean geometry, but the case of spherical geometry is even more obvious. In arithmetic we apparently only consider the "one and only" structure of the natural numbers. One may ask, then, why we feel entitled to use usual number symbols on a clock face, when they are meant to represent elements of the cyclic group $\mathbb{Z}/12\mathbb{Z}$.

Hilbert was asked by Max Dehn where he got his axioms for geometry. He answered:[6] "*Studiere Pasch!*"—"Study Pasch!" And Pasch considered the justification of axioms to be an independent task, which can be dubbed *promathematics*, *propaedeutics*, or the *narthex of geometry.*[7]

This narthex is, indeed, an undeveloped field of modern logic.

For Pasch, when considering Geometry, *experience* is crucial in the narthex. Extending the axiomatic method to arbitrary areas of investigation,

[4]Since there is not just one structure, Bernays [Ber50] can speak, quite correctly, of "*bezogene Existenz*" (related existence) with respect to existence claims in Mathematics.

[5]Bourbaki comments [Bou50, p. 225]: "It goes without saying that there is no longer any connection between this interpretation of the word 'axiom' [in an axiom system for groups] and its traditional meaning of 'evident truth'."

[6]See [Tam07, p. 62].

[7]See [Tam07, p. 80].

Hilbert liberalized the requirement and was to some extent only demanding consistency. Tamari [Tam07, p. 80] characterizes the difference neatly: The difference between Pasch and Hilbert is reduced to the fact that [Hilbert's] metamathematical method of proving consistency is a postcondition (*Nachtrag*) to the theory of geometry, whereas for Pasch it is a "precondition" ("*Vortrag*").

Pasch's justification is extrinsic (and, as one immediately notices, very much in line with Frege). But also Hilbert's approach is not a meaningless game of symbols. Axiom systems may be semantically motivated. Hilbert and Bernays [HB11, p. 2] make this clear: "Formal axiomatics requires contentual axiomatics as a necessary supplement. It is only the latter that provides us with some guidance for choosing the right formalism ...". And, additionally, the axiomatic method invites a certain form of idealization [HB11, p. 3]: "[I]n science we are predominantly—if not always—concerned with theories that do not reproduce the actual state of affairs completely, but whose significance consists in a *simplifying idealization* of the actual state of affairs."[8]

It was only later that Bourbaki turned the game around. Mathematics does not need to follow semantic specifications; rather, it provides alternative structures—here to be understood as given in an axiomatic way—from which one can choose [Bou50, p. 231]:

> From the axiomatic point of view, mathematics appears thus as a storehouse of abstract forms—the mathematical structures; and it so happens—without our knowledge why—that certain aspects of empirical reality fit themselves into these forms, as if through a kind of preadaptation. Of course, it can not be denied that most of these forms had originally a very definite intuitive content; but, it is exactly by deliberately throwing out this content, that it has been possible to give these forms all the power which they were capable of displaying and to prepare them for new interpretations and for the development of their full power.

When Mathematics produces such *abstract forms* for Bourbaki's storehouse, it can dispense with specific judgments concerning the choice of the axioms—although they may be, and probably will be, motivated by the original intuitive content, conceded by Bourbaki.

Interestingly, the philosopher Jürgen Habermas saw here—most likely without any knowledge of Bourbaki or even the axiomatic method—a new understanding of science, which went against his hope for societal engagement [Hab57, p. 65]:

[8] Georg Kreisel repeatedly criticised Hilbertian proof theory for studying only the structure of given axiomatic systems without addressing the question of where the axioms come from. He apparently deliberately ignored the opening paragraphs of Hilbert and Bernays's *Grundlagen der Mathematik*.

> Applicable science is neutral toward a social practice that now decides how to apply it without scientific guidance. It pays for its practicability by alienating itself from living, purposeful practice, becoming a "pure theory".

The axiomatic method seems, indeed, to support this estrangement of science from social practice. And Bourbaki even attempts to absolve itself of any responsibility for applications [Bou49, p. 2]:

> Why do such applications ever succeed? Why is a certain amount of logical reasoning occasionally helpful in practical life? Why have some of the most intricate theories in mathematics become an indispensable tool to the modern physicist, to the engineer, and to the manufacturer of atom-bombs? Fortunately for us, the mathematician does not feel called upon to answer such questions, nor should be held responsible for such use or misuse of his work.

But we may identify here a new quest for judgment: how is the choice of one abstract form over another justified when, for instance, a physicist picks it up from the storehouse?

We can refer back to Kant here. He stressed the *purposefulness* of axioms. And purposefulness, of course, applies also to abstract forms one would like to use. As a matter of fact, Euclidean geometry does not serve the purpose if it is used to investigate movements of light points in the night sky, as well as for the geometry of the surface of the Earth. That justifies (the introduction and) the use of spherical geometry.

In his *Kritik der Urteilskraft*, Kant had linked the *purposefulness*[9] (as a *principle a priori*) with *judgment* (as a *cognitive faculty*) but in Aesthetics for applications in art. We actually see a quite similar relationship between purposefulness and judgment in Philosophy of Science: an abstract form is judged with respect to its purpose.

There is another Kantian observation which supports our view. In the *Kritik der reinen Vernunft* he writes [Kan98, p. 241 (A125)]:

> Thus we ourselves bring into the appearances that order and regularity in them that we call nature, and moreover we would not be able to find it there if we, or the nature of our mind, had not originally put it there.

The bold interpretation is this: the *framework of concepts* is imposed on nature by us—and by *judgment*.

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[9] J. H. Bernard translates *Zweckmäßigkeit* as *purposiveness*, [Kan51, p. 34].

References

[Ber50] Paul Bernays. Mathematische Existenz und Widerspruchsfreiheit. In *Études de Philosophie des Sciences*, pages 11–25. Neuchâtel: Éditions du Griffon, 1950. Reprinted in [Ber76, p. 92–106].

[Ber76] Paul Bernays. *Abhandlungen zur Philosophie der Mathematik*. Wissenschaftliche Buchgesellschaft, 1976.

[Bou49] Nicolas Bourbaki. Foundations of mathematics for the working mathematician. *Journal of Symbolic Logic*, 14(1):1–8, 1949.

[Bou50] Nicholas Bourbaki. Architecture of mathematics. *The American Mathematical Monthly*, 57(4):221–232, 1950.

[Cou81] Richard Courant. Reminiscences from Hilbert's Göttingen. *The Mathematical Intelligencer*, 3(4):154–164, 1981. Edited transcript of a talk given at Yale University on January 13, 1964.

[Gö95] Kurt Gödel. The present situation in the foundations of mathematics. In *Collected Works. Volume III: Unpublished Essays and Lectures*, pages 45–53. Oxford, 1995. Handwritten text for an invited lecture which Gödel delivered to a meeting of the Mathematical Association of America, 29–30 December 1933.

[Hab57] Jürgen Habermas. Die chronischen Leiden der Hochschulreform. *Merkur*, März 1957. Reprinted in Jürgen Habermas. Protestbewegung und Hochschulreform, Suhrkamp, 1969, pp. 51–82; the page number in the text refers to this reprint.

[HB34] David Hilbert and Paul Bernays. *Grundlagen der Mathematik I*. Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, 40. Springer, 1934. 2nd edition 1968.

[HB11] David Hilbert and Paul Bernays. *Grundlagen der Mathematik I. Foundations of Mathematics I. Part A*. College Publications, 2011. Bilingual edition of the starting paragraphs of [HB34].

[Hil18] David Hilbert. Axiomatisches Denken. *Mathematische Annalen*, 78(3/4):405–415, 1918. Reprinted with English translation by J. Fang in [Hil22].

[Hil22] David Hilbert. Axiomatisches Denken. In Fernando Ferreira, Reinhard Kahle, and Giovanni Sommaruga, editors, *Axiomatic Thinking I*, pages 1–19. Springer, 2022. Address delivered by David Hilbert at the annual meeting of the Swiss Mathematical Society in Zurich

on September 11, 1917. Reprint of the German text from Mathematische Annalen, 78:405–415, 1918; with the English translation of Joong Fang, reprinted from Fang, J., editor, HILBERT–Towards a Philosophy of Modern Mathematics II, Paideia Press, Hauppauge, N.Y. 1970.

[Kan51] Immanuel Kant. *Critique of Judgment*. Hafner, 1951. Translated by J. H. Bernard. Original publication date 1892.

[Kan98] Immanuel Kant. *Critique of Pure Reason*. The Cambridge Edition of the Works of Immanuel Kant. Cambridge University Press, 1998. Translated by Paul Guyer and Allen W. Wood.

[ML87] Per Martin-Löf. Truth of a proposition, evidence of a judgement, validity of a proof. *Synthese*, 73:407–420, 1987.

[ML11] Per Martin-Löf. How did 'judgement' come to be a term of logic? Conférence de clôture de la Chaire Blaise Pascal, 14 October 2011. Video available on the website of the École Normale Supérieure.

[Smi00] Nicholas J. J. Smith. Frege's judgement stroke. *Australasian Journal of Philosophy*, 78(2):153–175, 2000.

[Tam07] Dov Tamari. *Moritz Pasch (1843–1930)*. Shaker Verlag, 2007.

Does the neopositivist refutation of Kant's synthetic a priori judgments rule out the possibility of meaningful philosophical principles?

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Abstract. This paper examines the philosophical implications of the rejection of the *synthetic a priori* in the context of 20th-century scientific advancements, particularly General Relativity. It begins by tracing the historical development of the *synthetic a priori* as a cornerstone of Kantian epistemology, emphasizing its role in grounding the certainty and necessity of scientific principles. However, the emergence of non-Euclidean geometries and Einstein's redefinition of space and time undermined this foundation, prompting logical empiricists such as Carnap and Reichenbach to refute the *synthetic a priori* as incompatible with empirical science.

Building on these critiques, the paper explores the reconciliation of logical empiricism and realism through Evandro Agazzi's innovative concept of scientific objectivity. His approach reframes scientific objects as structured collections of properties defined by specific criteria of objectivity, offering a middle ground between the empiricist demand for verifiability and the realist commitment to an independent reality.

The discussion concludes by advocating for a refined philosophical framework that retains the meaningfulness of metaphysical principles while respecting the empirical constraints of scientific practice. Through this synthesis, the paper highlights the enduring interplay between philosophy and science in shaping our understanding of reality.

1 Introduction

For centuries, philosophers have sought certain and incontrovertible knowledge, either in a transcendent reality, as in the case of Plato's doctrine of ideas, or within the sensory world of experience, identifying essences capable of explaining natural phenomena.

Before Immanuel Kant, metaphysics, fortunately, was not as obscure as that of the philosophers who followed him. At times, its arguments displayed exemplary clarity, as seen in the works of equally renowned philosophers whose theses and conclusions, while absolutely clear, are ultimately untenable. The underlying issue lies in metaphysical philosophy's claim to establish certain and necessary statements about the properties of the real world—a claim that even the most advanced scientific theories cannot sustain without risking becoming a new form of metaphysics. This problem is

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particularly evident in the Galilean perspective and, most notably, in Kantian interpretations of classical mechanics.

Consider, for instance, the cases of Anselm of Aosta and Descartes. Both attempted to derive synthetic conclusions from analytical premises[1]: the former seeks to establish the existence of God from the definition of God as a perfect being, while the latter endeavors to demonstrate the existence of the self (the ego) from the certainty of doubt. Let us examine them more closely.

The most notable attempt to establish the certainty of God's existence was made by Anselm of Aosta in the 11th century. Anselm's argument begins with the definition of God as an infinitely perfect being. Since such perfection necessitates that this being possesses all essential properties, it must therefore possess the property of existence. Consequently, one is led to the conclusion that God necessarily exists. However, the premise is clearly analytic, as it rests on a definition, while the conclusion is synthetic, implying the existence of God in the real world. The inference from essence to existence seems to be a logical sleight of hand, deriving a synthetic conclusion from an analytic premise.

Descartes, on the other hand, was deeply troubled by the uncertainty surrounding knowledge. In various writings, he offered arguments about the unreliability of our perceptions and even vowed a pilgrimage to the Sanctuary of Loreto, asking the Virgin Mary to illuminate his mind and help him discover absolute certainty. His proof of such certainty, though not obscure, contains a logical flaw. He argues that he can doubt everything except one thing: the fact that he doubts. But in doubting, he reasons, he must think; and if he thinks, he must exist.

In 1730, David Hume introduced his famous distinction, known as "Hume's fork". According to this distinction, all human knowledge can be classified into two categories of propositions, which he termed "relations of ideas" and "matters of fact." The former, as in the case of mathematical principles, are universal and necessary but devoid of any empirical significance, while the latter possess empirical content but lack universality and necessity. More specifically, Hume argued that every statement that is certain, such as those in geometry, arithmetic, and algebra, falls under "relations of ideas." For instance, the proposition that the square of the hypotenuse is equal to the sum of the squares of the other two sides is a relation of ideas. Such facts represent *a priori* knowledge and can be known purely through reasoning. However, according to Hume, they are not significant in the sense that they do not convey any information about the

[1]As is well known, a synthetic proposition is one that conveys information beyond what is contained in the subject's definition, adding new knowledge. In contrast, an analytic proposition states only what is already implicit in the definition of the subject, offering no additional information.

actual world. "Matters of fact", on the other hand, encompass *a posteriori* knowledge and consist of synthetic propositions that provide information about the world. However, they are not certain, as they rely on sensory experience and the principle of cause and effect. Matters of fact represent contingent truths, such as the statement that Donald Trump is the President of the USA—a proposition that is neither universally nor necessarily true.

All propositions that could not be classified into one of these two categories were to be rejected as false. A famous passage is that of Hume, in *An Enquiry Concerning Human Understanding*, published in 1748:

> When we run over libraries, persuaded of these principles, what havoc must we make? If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, *Does it contain any abstract reasoning concerning quantity or number?* No. *Does it contain any experimental reasoning concerning matter of fact and existence?* No. Commit it then to the flames: For it can contain nothing but sophistry and illusion. (Hume 2007, p. 144)

2 The Kantian synthetic a priori as a significant philosophical question

Kant attempted to overcome Hume's fork with the ingenious idea that the logical distinction between analytic and synthetic propositions does not necessarily correspond to the epistemological distinction between *a priori* and *a posteriori*, as Hume had thought (see Fig. 1, from Carnap 1966, p. 179).

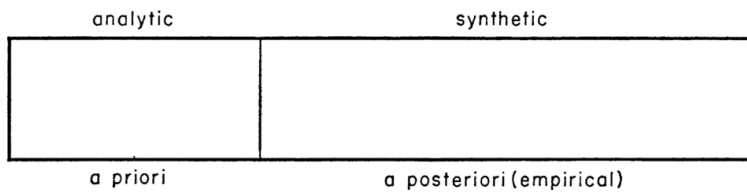

FIGURE 1. The boundary line between *a priori* and *a posteriori* coincides with the boundary line between analytic and synthetic.

It is true that all analytic knowledge is *a priori* and that all *a posteriori* knowledge is synthetic. However, there are instances in which certain synthetic forms of knowledge are *a priori*—meaning they are certain and necessary, yet not derived from experience. From this perspective, the logical distinction between analytic and synthetic no longer aligns with the epistemological distinction between *a priori* and *a posteriori* (see Fig. 2, from Carnap 1966, p. 179).

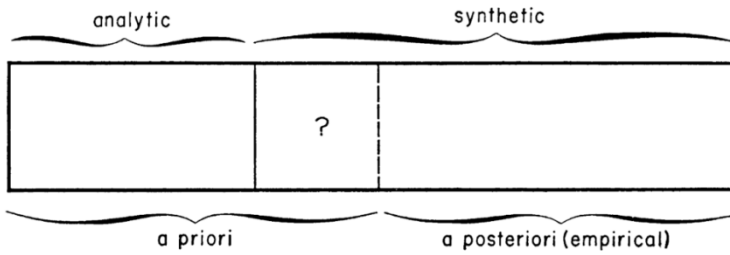

FIGURE 2. The boundary between *a priori* and *a posteriori* lies to the right of the boundary between analytic and synthetic, creating an intermediate zone where the synthetic overlaps with the *a priori*.

According to Kant, therefore, there exists a realm of knowledge that is both synthetic (insofar as it conveys information about the world) and *a priori* (because it can be known with certainty without requiring empirical justification). The existence of the synthetic *a priori* "is one of the great controversial questions in the history of the philosophy of science" (Carnap, 1966, p. 180).

Through this doctrine, Kant reestablished the non-contingent nature of classical physics, aligning himself with Galilean principles. These principles included the rejection of the Aristotelian essentialist conception, and posited that distinctions in nature explained the diversity of behaviors among natural objects, as well as affirmed the necessary character of the mathematical laws describing the world of phenomena. It was precisely the laws of classical physics that highlighted the existence of synthetic *a priori* judgments.

This passage from Reichenbach highlights the significance of Kant's approach to the synthetic *a priori* in the history of philosophy:

> If progress in the history of philosophy consists in the discovery of significant questions, Kant is to be assigned a high rank because of his question concerning the existence of a synthetic *a priori*. Like other philosophers, however, he claims merit not for the question but for his answer to it. He even formulates the question in a somewhat different way. He is so convinced of the existence of a synthetic *a priori* that he regards it as hardly necessary to ask whether there is one; therefore, he poses his question in the form: how is a synthetic *a priori* possible?
>
> The proof of its existence, he continues, is supplied by mathematics and mathematical physics. (Reichenbach 1951, p. 40)

For example, among the synthetic *a priori* judgments in mathematical physics are the conservation laws, such as the conservation of mass—the Newtonian concept of matter, considered indestructible. This idea had already been articulated by Lavoisier in 1789: "Nothing is created by human action

or in natural operations. It is a fundamental truth that in all operations there is the same quantity of matter before and afterward and that the quality and quantity of the material principles are the same; there are only alterations and modifications" (de Lavoisier 1789, p. 107).

Another example of a synthetic *a priori* judgment in mathematical physics is the principle of causality. According to Kant, while we may often fail to identify the cause of a particular observed event, we do not assume that the event occurred without a cause. Instead, we maintain confidence that a cause exists and that it can be discovered through further investigation.

As with other aspects of Kant's philosophy, the existence of the synthetic *a priori* is supported by reference to scientific methodology and practice.

3 The impossibility of synthetic *a priori* in General Relativity

The crisis of the Kantian foundation of science, based on synthetic *a priori* judgments, emerged with the advent of modern physics—namely General Relativity and Quantum Mechanics—at the beginning of the twentieth century, which profoundly transformed the Kantian framework. General Relativity, in particular, continued—so to speak—the assault on Kantian confidence in the reliability of scientific conclusions. It further emphasized the fragility of "classical" science by exposing a fundamental inadequacy in the basic ontology of Newtonian physics, specifically its enumeration of fundamental entities. For instance, in the Newtonian paradigm, gravity is conceptualized as a force, with forces representing one of the foundational elements of its ontology. In contrast, General Relativity reconceptualizes gravity not as a force but as a manifestation of the curvature of spacetime. This redefinition constituted the primary philosophical revolution introduced by General Relativity with respect to space and the geometry used to describe it. In the decade following its formulation, such a redefinition implied a profound reevaluation of the nature of geometric knowledge.

In truth, General Relativity culminated a trend that had already begun in the 19th century, when it was discovered that geometries other than Euclidean geometry were consistent and logically possible. This development began with Carl Friedrich Gauss, who, as early as 1816, formulated a non-Euclidean geometry with negative curvature—a discovery later made independently around 1829 by the mathematicians János Bolyai and Nikolai Ivanovich Lobachevsky. Gauss, however, refrained from publishing his work to avoid "the yelling of the Boeotians", as he later remarked.

Notably, Gauss was the first to recognize that a measure of length might be inherent in physical yet "empty" space. In other words, he understood that both small and large triangles must contain exactly two right angles only if we are in a Euclidean space. Motivated by this insight, he devised and

conducted an experiment to determine whether space was truly Euclidean on scales larger than those of everyday experience. As the director of the Göttingen Observatory, Gauss utilized an instrument of his own design to focus and reflect sunlight between three distant mountain peaks in the German principality of Hanover. His goal was to test the Euclidean hypothesis that the internal angles of the triangular formation of these peaks would sum to 180°. However, he realized that the confirmation he obtained of space's Euclidean nature was not decisive: a rigorous empirical test would require much greater distances, potentially on a stellar scale.

The important outcome of Gauss's efforts was the conceptual shift that geometry came to be seen as an empirical science akin to mechanics, unlike arithmetic, which Gauss assumed to be *a priori*. Consequently, the necessity and universality that Kant attributed to Euclidean axioms lost their philosophical grounding.

A few years later, Bernhard Riemann further enriched the field of non-Euclidean geometries with elliptic geometry, complementing hyperbolic geometry as the other traditional non-Euclidean system. Particularly noteworthy was the beginning of Riemann's famous lecture, delivered in Göttingen in 1854 and published in 1868. This text, recognized as one of the most important works in geometry, laid the foundation for what would come to be known as Riemannian geometry:

> It is known that geometry assumes, as things given, both the notion of space and the first principles of constructions in space. She gives definitions of them which are merely nominal, while the true determinations appear in the form of axioms. The relation of these assumptions remains consequently in darkness; we neither perceive whether and how far their connection is necessary, nor, *a priori*, whether it is possible. (in Jost 2016, p. 31)

Thus, with these foundational works, mathematicians began to recognize that these new geometries had to be taken seriously—even as physical possibilities for describing the geometry of actual space. The 18th-century notion that Euclid had uncovered the ultimate truth of geometry (and similarly that Newton had done the same in physics for mechanics, as Euclidean geometry was unquestioningly adopted as the foundation for 18th-century physics), a supposedly certain knowledge independent of experience, began to collapse. Geometry came to be understood as describing how our space actually *is*, rather than how it *ought to be*.

By the second half of the 19th century, however, these alternative geometries were regarded merely as unrealized possibilities: Nature, despite having many options, had apparently chosen Euclid's system. If the recognition of the mere logical possibility of geometries other than Euclid's was shocking, even more so was the realization—through General Relativity—that non-

Euclidean geometries were no longer merely unused possibilities in Nature, nor pure speculation, but actual physical realities. In the presence of strong gravitational fields, Nature itself selects non-Euclidean geometries: such geometries, characterized by variable curvature (depending on the distribution of matter and energy), represent our actual space, with Euclidean geometry holding only as an approximation.

This revolutionary perspective can even be associated with a specific date: November 6, 1919. On that occasion, the astronomer Arthur Eddington presented the results of his measurements of light deflection during the solar eclipse of May that year to the Royal Astronomical Society in London. The apparent displacement of the positions of stars, caused by the Sun's mass curving spacetime—and thus bending the trajectory of light—was considered the first experimental confirmation of General Relativity.

The discovery of non-Euclidean geometries had a ripple effect that extended far beyond the boundaries of mathematics and science. The immediate philosophical casualty of Einstein's theory, of course, was one of the most successful epistemologies: that of Kant. In Kant's account of human knowledge, geometry held a special role. The science of Euclidean geometry was paradigmatic of synthetic *a priori* truths—truths that were certain and necessary (neither derived from the senses nor deduced through logic) and known independently of any particular experience, yet genuinely descriptive and applicable to physical or empirical reality. Synthetic *a priori* truths were propositions about the world that could simultaneously be regarded as true even prior to any experience of it. Euclidean geometry was a repository of such truths. According to Kant, Euclid's postulates were synthetic *a priori* conditions, as they expressed the necessity and universality of the form of outer intuition.

General Relativity, however, demonstrated that the laws of geometry were neither truths nor *a priori*. Geometry did not necessarily have to be Euclidean, and its validity was something to be discovered empirically in the world.

4 The rejection of synthetic *a priori* judgments as the fundamental thesis of logical empiricism

The logical empiricism of the early 20th century—represented by Moritz Schlick, Hans Reichenbach, and Rudolf Carnap—openly acknowledged the influence of the theory of relativity in shaping the core of its philosophical perspective. This groundbreaking application of non-Euclidean geometry to physics—the first of its kind—has been regarded, since the emergence of logical empiricism (from which later developments in the philosophy of science have arisen, albeit often in a critical spirit), as a definitive refutation

of the Kantian philosophy of geometry and, by implication, as a decisive rejection of the broader Kantian doctrine of the synthetic *a priori*.

In his 1951 book, Reichenbach wrote:

> I do not wish to be irreverent to the philosopher of the Enlightenment. We are able to raise this criticism because we have seen physics enter a stage in which the Kantian frame of knowledge does break down. The axioms of Euclidean geometry, the principles of causality and substance are no longer recognized by the physics of our day. We know that mathematics is analytic and that all applications of mathematics to physical reality, including physical geometry, are of an empirical validity and subject to correction by further experience; in other words, that there is no synthetic *a priori*. But it is only now, after the physics of Newton and the geometry of Euclid have been superseded, that such knowledge is ours. (Reichenbach 1951, p. 48)

Carnap's perspective was similarly critical of Kant and aligned with Moritz Schlick's identification of logical empiricism as the philosophy that rejects the existence of synthetic *a priori* judgments: "Indeed, as Schlick once remarked, empiricism can be defined as the point of view that maintains that there is no synthetic *a priori*. If the whole of empiricism is to be compressed into a nutshell, this is one way of doing it" (Carnap 1966, p. 180).

As is widely recognized, a central tenet of logical empiricism was the verification principle (or verificationism), which asserts that a statement is meaningful only if it is empirically verifiable—capable of being confirmed through sensory experience—or a tautology, true by virtue of its meaning or logical form. This principle is articulated by Alfred Ayer, one of the most prominent proponents of logical positivism, in the following formulation:

> The criterion which we use to test the genuineness of apparent statements of fact is the criterion of verifiability. We say that a sentence is factually significant to any given person, if, and only if, he knows how to verify the proposition which it purports to express—that is, if he knows what observations would lead him, under certain conditions, to accept the proposition as being true, or reject it as being false. If, on the other hand, the putative proposition is of such a character that the assumption of its truth, or falsehood, is consistent with any assumption whatsoever concerning the nature of his future experience, then, as far as he, is concerned, it is, if not a tautology, a mere pseudo-proposition. (Ayer 1951, p. 10)

The neo-positivists drew inspiration from the anti-metaphysical program initiated by Mach's critique of classical physics. This critique, which eliminated the concepts of absolute space and time, as well as the notion of undisturbed object trajectories, gave rise to two groundbreaking theories in 20th-century physics. However, the anti-metaphysical program of physics

was eventually extended to philosophy. These anti-metaphysical conclusions evolved into an anti-philosophical stance following the rejection of the synthetic *a priori*, which the neo-positivists regarded as the only coherent attempt to construct a metaphysical framework.

This perspective led the verificationists to dismiss statements in metaphysics, theology, ethics, and aesthetics as devoid of truth value or factual content. While such statements were acknowledged as meaningful in their capacity to influence emotions or behavior, they were deemed meaningless in terms of conveying cognitive or empirical content. As a result, the central claims of traditional philosophy were rejected by logical empiricists as lacking cognitive content—they were seen as neither true nor false, as they typically corresponded to metaphysical propositions of existential import that are not empirically testable and offer no method for determining their truth.

In summary, logical empiricists arrived at the controversial conclusion that no philosophical principle possesses inherent meaning, thereby relegating meaning exclusively to scientific propositions. As Weinberg put it: "The ultimate and definitive doctrine of logical positivism is that the only proposition endowed with meaning are those of science" (Weinberg 1936, p. 105). Consequently, philosophical propositions were considered non-existent, as Neurath asserted: "All the representatives of the Circle are in agreement that 'philosophy' does not exist as a discipline, alongside of science, with propositions of its own: the body of scientific propositions exhausts the sum of all meaningful statements" (Neurath 1959, p. 282).

Even the thesis of realism was subjected to refutation: Carnap, followed by Ayer, sought to demonstrate the complete lack of meaning in both realism and its antithesis, idealism.

Ryckman recounts a particularly explicit statement made by Schlick—the éminence grise of the Vienna Circle and logical empiricism more broadly—in 1922, in Vienna, at the centenary meeting of the *German Society of Natural Scientists and Doctors*, on the topic of "The Theory of Relativity in Philosophy":

> Now along comes the general theory of relativity, and finds itself obliged to use non-Euclidean geometry in order to describe this same world. Through Einstein, therefore, what Riemann and Helmholtz claimed as a possibility has now become a reality, the Kantian position is untenable, and empiricist philosophy has gained one of its most brilliant triumphs. (in Ryckman 2005, p. 5)

According to Schlick, and later other logical empiricists, the collapse of the synthetic *a priori* in geometrical space signified a broader triumph of empiricism over metaphysical and idealist philosophies. For the logical empiricists, mathematical statements were reducible to logical statements, and purely mathematical truths were essentially logical truths—hence ana-

lytic, meaning they were true by virtue of the meanings of the terms they contained. This view reinforced the central thesis of logical empiricism: any meaningful statement is either analytic or a synthetic *a posteriori* statement, the latter being confirmable or refutable by experience.

Although General Relativity served as a significant stimulus for philosophical reflection, the question of whether it supports any specific philosophical interpretation remains contentious. Indeed, the cornerstone belief of logical empiricists—namely, as already mentioned, that this theory had definitively established the untenability of any "philosophy of the synthetic *a priori*"—should not be taken for granted,[2] particularly in light of significant neo-Kantian developments in Kantian thought by figures such as Ernst Cassirer, Hermann Weyl, and Arthur Stanley Eddington.

In the early 1920s, Schlick, responding to the growing neo-Kantian reaction to relativity, adopted the notion of convention as an alternative to the Kantian *a priori*. He suggested that "the 'constitutive principles' whereby experience is ordered and interpreted are more helpfully characterized as conventions than as elements of either a contingent or an apodictic *a priori* component of scientific cognition" (Howard 2014, p. 363). Einstein, who was in close and regular contact with Schlick at the time, had proposed a similar idea over the course of several years.

5 Einstein on Kant

It is beyond the scope of this discussion to provide a comprehensive account of Einstein's relationship with Kantian *a priori* principles. However, some of his reflections may be helpful in framing or contextualizing this relationship. In a letter to Max Born dated July 1918, Einstein wrote:

> I am reading Kant's *Prolegomena* here, among other things, and am beginning to comprehend the enormous suggestive power that emanated from the fellow and still does. Once you concede to him merely the existence of synthetic *a priori* judgments, you are trapped. I have to water down the '*a priori*' to 'conventional,' so as not to have to contradict him, but even then the details do not fit. Anyway it is very nice to read, even if it is not as good as his predecessor Hume's work. Hume also had a far sounder instinct (in Howard 2014, p. 363).

Essentially, Einstein reiterated the same point—that what Kant regarded as *a priori* should more appropriately be understood as conventional in nature—in numerous comments he made on the subject up until the mid-1920s.[3]

[2] See Ryckman (2024).
[3] See Howard (1994).

A famous and subtly critical remark about Kant is also found at the beginning of Einstein's renowned 1921 essay, "Geometry and experience".[4] In this work, Einstein delved more deeply into the philosophical issues underlying General Relativity, particularly his assertion that the axioms of geometry are "free creations of the human mind." He wondered:

> At this point a riddle presents itself that has troubled researchers throughout the ages. How is it possible that mathematics, being after all a product of human thought that is independent of experience, is so admirably appropriate to the objects of reality? Can human reason, then, without experience, through pure thought fathom the properties of real things? In my opinion, the answer to this question is, briefly, this: As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality. (Einstein 1921, p. 147)

Thus, in his response—arguably the most well-known passage of this paper—which is the most well-known passage of this paper, Einstein argued that Kantian synthetic *a priori* propositions cannot exist because mathematical propositions, including those of geometry, can be either synthetic (and thus "referring to reality") or *a priori* (and thus "certain"), but not both.

During a famous discussion with French luminaries at the *Collège de France* in April 1922, Einstein instead remained neutral in the choice between Kantian *a priori* principles and Poincaréan conventionalism, as Ryckman recounts, with some astonishment:

> It seems to me that the most important matter in Kant's philosophy is that one speaks of *a priori* concepts in the construction of science. But here there are two opposing viewpoints: the apriorism of Kant, in which certain concepts preexist in our mind, and the conventionalism of Poincaré. These two points of view agree on the point that science requires, for its construction, arbitrary concepts; with regard to whether these concepts are given *a priori* or are arbitrary conventions, I cannot say. (Ryckman 2014, p. 388)

Shortly thereafter, in 1924, in a review of Alfred C. Elsbach's text *Kant und Einstein*, Einstein provided a more comprehensive account of his negative assessment of the Kantian synthetic *a priori*, writing:

> Until some time ago, it could be regarded as possible that Kant's system of *a priori* concepts and norms really could withstand the test of time. This was defensible as long as the content of later science

[4] On this topic, and concerning the relationship between the problem of geometry in General Relativity and the philosophy of logical empiricism, see Friedman (2002; 2008) and Ryckman (2017, ch. 7).

> held to be confirmed* did not violate those norms. This case occurred indisputably only with the theory of relativity. However, if one does not want to assert that relativity theory goes against reason, one cannot retain the *a priori* concepts and norms of Kant's system.
>
> *[Footnote: To refute Kant's system it actually suffices to indicate a logically *conceivable* theory (corresponding to *conceivable* observational material) that conflicts with Kantian norms. Whether non-Euclidean geometries accomplished this remained controversial.]
>
> For starters, this does not exclude, at least, the retention of Kant's *way of posing the problem* [...]. I am even of the opinion that this standpoint cannot be strictly refuted by any scientific development. For, one will always be able to say that critical philosophers had hitherto erred in setting up the *a priori* elements and one will always be able to set up a system of *a priori* elements that does not conflict with a given physical system. I surely may briefly indicate why I do not find this standpoint natural. Let a physical theory consist of the parts (elements) A, B, C, D, which together form a logical whole that correctly connects the pertinent experiments (sensory experiences). Then the tendency is that less than all four elements, e.g., A, B, D, still say nothing about the experiences, *without* C; no more so A, B, C, without D. One is then free to regard three of these elements, e.g., A, B, C, as *a priori* and only D as empirically determined. What always remains unsatisfactory in this is the *arbitrariness of the choice* of elements to be designated as *a priori*, even disregarding that the theory could be replaced at some point by another theory that substitutes some of these elements (or all four of them) with others. One could be of the view, though, that through direct analysis of human reason, or thought, we would be in a position to recognize elements that would have to be present in *any* theory. But most researchers would probably agree that we lack a method for recognizing such elements, even if one were inclined to believe in their existence. Or should one imagine that the search for *a priori* elements was a kind of asymptotic process that advances along with the development of science? (in Norton 2017)

So Einstein, although skeptical and firmly confident in the ultimate authority of experience, recognized the relevance of the problem of identifying *a priori* elements—and therefore the significance of the Kantian approach to this issue—as Ryckman points out: "Notwithstanding well-known railings against Kant's unsustainable doctrine of synthetic *a priori* concepts and judgments, the later Einstein affirmed that while experience alone remained the ultimate arbiter of any theory, a 'belief in the comprehensibility of reality through something logically simple and unified' was a methodologically legitimate heuristic, whose general form Kant had thoroughly probed in the 'Transcendental Dialectic' of the *Critique of Pure Reason*" (Ryckman 2017, p. 344).

6 The dissolution of the synthetic *a priori* does not preclude the existence of meaningful philosophical principles

The fact that Kant's attempt was both highly significant and extraordinary is beyond question, as even Einstein's early reflections demonstrate. Moreover, the logical positivists themselves acknowledged that of all metaphysical doctrines, only one possessed meaning: the doctrine asserting the existence of synthetic *a priori* propositions. Although the transcendental constitution of objectivity in Kantian terms ultimately failed, this does not imply the invalidity of the "belief in the comprehensibility of reality through something logically simple and unified", as Einstein maintained. Nor does it mean that it is no longer possible to pursue a "good metaphysics"—that is, to formulate valid and meaningful philosophical principles.

In other words, the recognition that certainty and necessity cannot be combined does entail a return to Hume's view that grand philosophical questions are meaningless. The logical positivists sought to equate meaning with scientific validity. In concluding that—given their refutation of the synthetic *a priori* and their critique of metaphysics—only scientific propositions were meaningful, they inadvertently conflated their principle of verifiability with a principle of scientific demarcation, that is, of distinguishing science from non-science.

From Popper onwards, however, it has been understood that what is meaningful is not necessarily scientific. There exists a domain of statements that, while meaningful, are unfalsifiable and thus pseudo-scientific. The boundary between what is meaningful and meaningless, therefore, does not coincide with the distinction between scientific and pseudo-scientific.[5]

Philosophical propositions, while differing in status from scientific ones, can still have meaning, even if they are unfalsifiable and thus non-scientific. This perspective, however, repositions philosophy in a more modest role compared to Kantian philosophy: it no longer aims to establish certain and necessary knowledge that is impervious to empirical falsification. Instead, it aspires to provide regulative principles for describing the world of experience—principles that may be accepted or rejected within specific theoretical contexts, but which are not universally invalidated by the entire domain of experience.

More specifically, while scientific principles engage directly with experience and are subject to refutation, philosophical principles engage with the scientific theories through which we describe that experience, as their scope of application is defined precisely by those theories. Scientific theories, being rooted in empirical observations, are falsifiable when they conflict

[5]See Tarozzi (1988), particularly the diagram on p. 102.

with experience, whereas philosophical principles are falsifiable only within the bounds of a specific theoretical framework (e.g., determinism, which is applicable in classical physics but not in quantum mechanics). Consequently, experience directly determines the validity of scientific theories and indirectly influences the validity of philosophical principles, insofar as these principles are assessed in relation to theoretical contexts or in relation to specific principles within them, rather than in direct confrontation with experience itself.

Historically, the foundations of quantum mechanics have opened up new possibilities for rethinking and reformulating metaphysical principles and concepts. Just as classical physics in Kant's era provided the foundation for synthetic *a priori* propositions, grounded in the Euclidean metric of space and the causal laws governing matter conservation, quantum mechanics has introduced a radically different philosophical framework. By rejecting the synthetic *a priori* through Bohr's principle of complementarity[6], quantum mechanics has demonstrated the factual relevance of alternative philosophical principles, thereby reviving—under new forms—longstanding metaphysical controversies that had previously been dismissed as meaningless pseudo-problems.

Several examples can be identified of thoroughly meaningful philosophical issues that are applicable exclusively within specific scientific theories and that, particularly in quantum mechanics, present significant challenges. Such issues include realism[7], causality[8], determinism[9], holism[10], the mind-body relation[11] and the concept of nothingness[12].

In what follows, we will further examine one of these issues—realism—drawing once again on logical positivism and Evandro Agazzi's realist conception.

7 Was neopositivism truly antirealistic?

Neopositivists were generally not realists in the metaphysical sense but rather empiricists, frequently associated, as often reiterated, with an anti-metaphysical stance. Their philosophy was based on the idea that the meaning of propositions derives either from their empirical verifiability or their logical validity. Statements lacking empirical criteria for verification were considered pseudo-propositions, devoid of cognitive significance. This

[6]See Covoni et al. (2024).
[7]See Selleri & Tarozzi (1981), Tarozzi (1981), Auletta & Tarozzi (2004).
[8]See Tarozzi & Macchia (2021).
[9]See Tarozzi (1988b).
[10]See Calosi et al. (2011).
[11]See Calosi & Tarozzi (2013), Corti et al. (2023).
[12]See Afriat & Tarozzi (2006).

positioned them in opposition to metaphysical realism, which posits the independent existence of objects or structures in the world.

Although many neopositivists refrained from strong metaphysical commitments, some adopted a form of empirical or structural realism, maintaining that scientific theories provide a representation of the world—albeit limited to what can be observed or measured. For instance, realism regarding theoretical terms (such as "electrons") was not fully embraced, as such entities are not directly observable. Certain neopositivists leaned toward an instrumentalist approach, viewing scientific theories as tools for organizing and predicting sensory data rather than as literal descriptions of reality.

It is important to acknowledge differences among members of the Vienna Circle and other neopositivist thinkers. For example, Rudolf Carnap displayed openness to "methodological tolerance", deliberately abstaining from taking a stance on the ontological status of theoretical entities.

In summary, neopositivists were not strong or metaphysical realists, but their empiricism could align with a form of realism confined to observable and operationally definable aspects of science.

In addressing the question of whether neopositivism genuinely embraced a realist perspective on science, Evandro Agazzi provides an affirmative response:

> The epistemology of neo-positivism, despite having been profoundly influenced by Mach's thought, ended up accepting more or less explicitly a realistic view of science.
>
> ... the obsession with which neo-empiricism has tried to impose the most absolute fidelity to experience and the reducibility to it of the same theoretical components of the sciences can also be considered as an effort to ensure science a solid connection with reality (Agazzi 1985, p. 173).

In Agazzi's realist conception, the connection between knowledge and reality is ensured by the operational and interactive nature of the relationship established between the subject and reality, as articulated in his doctrine of "objectification." Within this philosophical framework, each science investigates objects solely through the lens of specific fundamental attributes, for which it has distinct criteria for their assignment. These criteria essentially consist of operations, which naturally include observation and measurement but are more broadly conceived as forms of interaction with the objects under investigation.

Observational or "protocol" propositions are those that affirm or deny a fundamental attribute of an object and are directly verifiable through the aforementioned operations. Each science subsequently introduces its own theoretical attributes, which are defined through relationships among these basic attributes. Theoretical propositions pertain to such attributes, and

their assertability is established through rational inferences derived from protocol propositions and, where applicable, other theoretical propositions.

According to Agazzi, a scientific object is essentially a collection of predicates:

> ... a scientific object is a 'thing' conceived from a particular point of view, the general nature of the object being determined by means of the criteria of objectivity of the science in question. Thus the adoption of a given set of such criteria '*clips out*' some particular object, while the adoption of a different set of criteria 'clips out' a different object, both from one and the same individual 'thing.' We can leave aside this metaphor of 'clibbing out,' and express the matter in a linguistic form. Thus we should say that an object of a given science contains only (and all) the aspects of a 'thing' which may be characterized by the basic predicates of that science. In this sense [...] *a scientific object is nothing other than a bunch of predicates.* (Agazzi 2014a, pp. 89–90).

Thus, according to Agazzi, a scientific object is defined by the criteria of objectivity specific to a particular science, which determine its general nature. These criteria isolate certain aspects of a 'thing' as relevant to that science, while different criteria may isolate other aspects. In essence, a scientific object can be understood as a structured collection of predicates that characterize the aspects of a 'thing' pertinent to the science in question. In this way, Agazzi proposed a reconciliation between logical empiricism and realism through his conception of scientific objectivity, replacing the notion of an entity with that of an object, understood as a structured set of properties.

8 Property realism and entity realism

The earlier conception of scientific objectivity significantly influenced the research of one of us (G.T.) on the foundations of quantum mechanics, originally conducted from a strictly logical empiricist perspective. This approach initially led G.T. to attempt, albeit unsuccessfully, to demonstrate the redundancy of the hypothesis asserting the validity of the physical reality principle of EPR in the derivation of their renowned paradox and Bell's theorem. According to logical empiricists, philosophical principles are devoid of meaning unless they lead to empirically testable consequences; therefore, adopting or rejecting such a principle should yield the same conclusions. Contrary to expectations, however, these efforts revealed the opposite result: the EPR principle emerged as a necessary condition for deriving the paradox and proving the theorem.

This principle, as is well known, equated predictability with certainty through the mathematical laws of quantum mechanics themselves. This

alignment constituted a robust form of scientific objectivity, serving as a sufficient condition for reality, as argued by Agazzi in his *Temi e problemi di filosofia della fisica*, where he asserted that "the position of correct realism, on the other hand, is the one that between objective and real sees a relationship of *inclusion*: everything that is objective is real, although not everything that is real is objective" (1969, p. 365). Now, since predictability pertains to the properties or attributes of an object, rather than to the object itself—or even to the existence of an object (as Kant had already pointed out before the neopositivists, since existence is not a property of an object)—an empirical radicalization of Agazzi's position has led to a form of property realism capable of satisfying the factual significance requirements of neopositivism.

A significant convergence and agreement between realism of properties and realism of objects, grounded in Agazzi's objectivism, had already been identified in G.T.'s original formulation: "[...] when we assert the reality of the predictable attributes or properties of an object, we maintain *implicitly* also the reality of the object itself, assuming once more a shape of independence from our perceptions" (Tarozzi 1980, p. 97).

This view was later confirmed by Agazzi himself, as reflected in the following excerpt:

> The comments that we want to propose about the issue of the realism of properties will shorten very much its distance from a form of entities realism, by dissolving the ambiguity inhering to the concept 'entity' itself. The first step will be the replacement of the term 'entity' by the term 'object' [...] in such a way that it consists in a 'structured set of properties', and from this follows the consequence that attributing 'reality' to properties amounts to attributing reality to the objects as well. (Agazzi 2014b, p. 23)

This nuanced perspective not only bridges the gap between property realism and entity realism, but also reaffirms the interdependence of empirical and theoretical considerations in defining scientific objectivity. By emphasizing the structured and relational nature of scientific objects, Agazzi's framework, as well as the modified proposal of G.T., offers a robust philosophical grounding for interpreting the predictive and explanatory power of scientific theories.

9 Conclusions

This paper has traced key moments in the complex trajectory of the *synthetic a priori*, from its Kantian origins—where it was firmly tied to the universality and necessity of scientific knowledge—to its eventual dissolution in the wake of General Relativity and logical empiricism. Despite the critique advanced by logical positivists, which led to a significant narrowing of what could be deemed cognitively meaningful, the subsequent

dialogue with neo-Kantian thought and the philosophical interpretation of quantum mechanics demonstrate the enduring relevance of philosophical principles within scientific contexts. The dissolution of the synthetic *a priori* does not preclude the possibility of meaningful philosophical inquiry, but rather invites its reformulation in the light of evolving scientific paradigms. Indeed, Agazzi's conceptualization of scientific objectivity—as rooted in structured sets of properties—underscores that realism, far from being a purely metaphysical stance, can be productively connected to empirically testable theories. By accommodating both the empirical demands of logical empiricism and the ontological commitments of realism, property realism offers a pathway to re-envision philosophical principles not as sterile *a priori* commitments, but as regulative frameworks subject to theoretical assessment. This integrated approach reaffirms the ongoing and indispensable role of philosophical analysis in shaping how we conceive of—and engage with—scientific theories.

References

Afriat A., Tarozzi G. (2006), "Can Nothing Cause Nonlocal Quantum Jumps?", in *Quantum Mechanics. Are There Quantum Jumps?* ed. by A. Bassi et al., American Institute of Physics, Melville, New York, pp. 3–7.

Agazzi, E. (1969), *Temi e problemi di filosofia della fisica*, Manfredi, Milano.

Agazzi, E. (1985), "La questione del realismo scientifico", in C. Mangione (ed.), *Scienza e filosofia. Saggi in onore di Ludovico Geymonat*, Garzanti, Milano, pp. 171–192.

Agazzi, E. (2014a), *Scientific Objectivity and Its Contexts*, Heidelberg, Springer.

Agazzi, E. (2014b), "Realism of properties and realism of entities", in V. Fano (ed.), *Gino Tarozzi, Philosopher of Physics*, Franco Angeli, Milano, pp. 22–32.

Auletta G., Tarozzi G. (2004),"On the Reality of Quantum Waves", *Foundations of Physics*, 34–35, pp. 1675–1694.

Ayer, A. J. (1951), *Language, Truth and Logic*, V. Gollancz, London.

Calosi C., Fano V., Tarozzi G. (2011) "Quantum Ontology and Extensional Mereology", *Foundations of Physics*, 41, pp. 1740–1755.

Calosi C., Tarozzi G. (2013) "Is the Mind a Quantum Computer?", *Epistemologia*, XXXVI, pp. 194–206.

Carnap, R. (1966), *Philosophical Foundations of Physics: An Introduction to the Philosophy of Science*, Basic Books, New York & London.

Corti A., Fano V., Tarozzi, G. (2023), "A Logico-Epistemic Investigation of Frauchiger and Renner's Paradox", *International Journal of Theoretical Physics* 62:54.

Covoni, N., Macchia, G., Pietrini, D., Tarozzi, G. (2024), "Non-standard realistic models of quantum phenomena and new forms of complementarity", in H.-P. Grosshans (ed.), *Models and Representations in Science*, in *Proceedings of the Académie Internationale de Philosophie des Sciences* 3, pp. 39–54.

Covoni, N., Tarozzi, G. (2024), "Empiricism and Realism Reconciled in Agazzi's Conception of Scientific Objectivity", *Distinctio: Journal of Intersubjective Studies*, 3(1), pp. 47–55.

de Lavoisier, A.-L. (1789), *Traité élémentaire de chimie*, Cuchet, Paris.

Einstein, A. (1921), "Geometry and Experience", *CPAE* 7 (2002), English translation supplement, Doc. 52, pp. 208–222; also in P. Pesic (ed.), *Beyond Geometry. Classic Papers from Riemann to Einstein*, Dover Publ., Mineaola, New York, pp. 147–157.

Friedman, M. (2002), "Physics, Philosophy, and the Foundations of Geometry", *Diálogos* 37, pp. 121–42.

Friedman, M. (2008), "Space, Time, and Geometry: Einstein and Logical Empiricism", in P. Galison, G. Holton & S. Schweber (eds.), *Einstein for the 21st Century: His Legacy in Science, Art, and Modern Culture*, Princeton University Press, Princeton, NJ, pp. 205–216.

Howard, D. (2014), "Einstein and the Development of Twentieth-Century Philosophy of Science, in M. Janssen and C. Lehner (eds.), *The Cambridge Companion to Einstein*, Cambridge University Press, Cambridge, pp. 354–376.

Hume, D. (2007), *An Enquiry Concerning Human Understanding. And Other Writings*, ed. by S. Buckle, Cambridge, Cambridge University Press.

Jost, J. (2016), Bernhard Riemann. On the Hypotheses Which Lie at the Bases of Geometry. Birkhäuser.

Neurath, O. (1959), *Sociology and Physicalism*, in A. J. Ayer (ed.), *Logical Positivism*, The Free Press, Glencoe (Illinois), pp. 282–317.

Norton, J. (2017), "Einstein on Kant", in J. Norton, *Einstein for Everyone*, Nullarbor Press, Pittsburgh (Pennsylvania).

Reichenbach, H. (1951), *The rise of scientific philosophy*, University of California Press, Berkeley.

Ryckman, T. (2014), "'A Believing Rationalist': Einstein and 'the Truly Valuable' in Kant", in M. Janssen and C. Lehner (eds.), *The Cambridge Companion to Einstein*, Cambridge University Press, Cambridge, pp. 377–397.

Ryckman, T. (2017), *Einstein*, Routledge, London and New York.

Ryckman, T. (2024), "Early Philosophical Interpretations of General Relativity", in E. Zalta (ed.), *Stanford Encyclopedia of Philosophy*, Edition Summer 2024.

Selleri F., Tarozzi, G. (1981), "Quantum Mechanics, Reality and Separability", *Rivista Nuovo Cimento*, 4(2), pp. 1–54.

Tarozzi, G. (1980), "Realism as a meaningful philosophical hypothesis", in *Atti della Accademia delle Scienze dell'Istituto di Bologna*, XIII, VII, pp. 89–98.

Tarozzi, G. (1981) "Realisme d'Einstein et mècanique quantique: un cas de contradiction entre une théorie physique et un hypothèse philosophique clairement définie", *Revue de Synthèse* 101–102, pp. 125–158

Tarozzi, G. (1988a), "Science, Metaphysics and Meaningful Philosophical Principles", *Epistemologia* 11, pp. 97–104.

Tarozzi, G. (1988b), "Probability and Determinism in Quantum Theory", in *Probability in the Sciences*, ed. by E. Agazzi, Kluwer, Dordrecht, pp. 237–259.

Tarozzi, G., Macchia, G. (2021), "No-Thing and Causality in Realistic Non-Standard Interpretations of the Quantum Mechanical Wave Function: *Ex Nihilo Aliquid*?", *Foundations of Science* 28, pp. 159–184.

Weinberg, J. (1936), *An Examination of Logical Positivism*, Kegan Paul and Co., London.

On the *Wertfreiheit* of science: objective knowledge and axiology

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> Knowledge, like the growth of a plant and the movement of the earth, is a mode of interaction; but it is a mode which renders other modes luminous, important, valuable, capable of direction, causes being translated into means and effects into consequences.
>
> John Dewey, *Experience and Nature*

1 Facts and values: the crisis of "Hume's law"?

The following passage by Hume, taken from *A Treatise of Human Nature* is celebrated:

> In every system of morality, which I have hitherto met with, I have always remark'd, that the author proceeds for some time in the ordinary way of reasoning, and establishes the being of a God, or makes observations concerning human affairs; when of a sudden I am surpriz'd to find, that instead of the usual copulations of propositions, *is*, and *is not*, I meet with no proposition that is not connected with an *ought*, or an *ought not*. This change is imperceptible; but is, however, of the last consequence. For as this *ought*, or *ought not*, expresses some new relation or affirmation, 'tis necessary that it shou'd be observ'd and explain'd; and at the same time that a reason should be given, for what seems altogether inconceivable, how this new relation can be a deduction from others, which are entirely different from it. But as authors do not commonly use this precaution, I shall presume to recommend it to the readers; and am persuaded, that this small attention wou'd subvert all the vulgar systems of morality, and let us see, that the distinction of vice and virtue is not founded merely on the relations of objects, nor is perceiv'd by reason.[1]

In this way Hume introduces what is called "Hume's law", which affirms the existence of a clear and drastic distinction between facts and evaluations, between reason and morality, therefore between the dimension of scientific knowledge and the development of human passions and actions. In short, we could say more briefly, between the world of objective scientific knowledge

[1] David Hume, *A Treatise of Human Nature*, reprinted from the Original Edition in three volumes and edited, with an analytical index, by L. A. Selby-Bigge, M.A., Oxford, Clarendon Press, 1896. p. 319, italics in the text; the passage is found in the final part of the first section of the first part of the third book.

The Relevance of Judgment for Philosophy of Science, edited by Jure Zovko.
Comptes Rendus de l'Académie Internationale de Philosophie des Sciences 4 (2025).
F. Minazzi, On the *Wertfreiheit* of science: objective knowledge and axiology, pp. 117–157.

and the world of values. Which allows us to immediately identify, *à la* Hume indeed, the traditional 'moralistic fallacy' according to which what *'is'* is systematically transformed, surreptitiously, into an *'ought to be'*. Hume's empirical point of view thus allows us to critically denounce a widespread model of metaphysical argument which, in general, unduly contaminates the axiological point of view with the ontological one in order to make a *de facto* situation look like *a de jure* one: 'p' *must be* true because p is good' or, and conversely, 'p' *must be* false, because p is bad'. This refers, at least within the established metaphysical tradition of Western philosophy, to a peculiar (fallacious) form of 'general argument' which assumes the following argumentative model as its privileged model of inference: 'p' implies 'q', but q is bad, *therefore* 'p' *must be* false' or, and conversely, 'p' implies 'q', but q is good, *therefore* 'p' *must be* true'.

In relation to the circumscribed, but certainly eminent, Humean reflection, Mario Dal Pra observed that

> Hume's doctrine of the radical gap between the world of knowledge and the development of the passions is of great importance for the formulation of his ethical doctrine; in fact, on the basis of the basic ambiguity that characterises the Humean construction, and due to the non-rigorous distinction between the descriptive sphere and the critical-philosophical level, on the one hand it gives rise to a complete 'psychological' autonomy of the world of passions, on the other it expresses the principled opposition to intellectualistic-metaphysical ethics; Hume's general opposition to the metaphysical perspective was in fact determined, in the field of ethics, as an aversion to the *a priori* acceptance of 'duties' imposed on the nature of human beings in the name of the metaphysical and religious tradition and of its claimed absolute validity. Hume's ethics therefore assume a general naturalistic orientation, in the sense that it aims at detecting human values in the autonomous mixture of human passions and natural motives. Undoubtedly, through this doctrine, Hume reached a broader understanding of the values that have been revealed in the complex experience of history and led the way to passing from *a moral philosophy* to *a philosophy of morality*, which by renouncing any claim to cognitive determination in relation to the world of values, is better disposed to consider them as autonomous and spontaneous products of human initiative.[2]

This, as mentioned, certainly helps us to better understand, *analytically*, the overall nature of Hume's innovative, decidedly anti-metaphysical reflection as well as its specific development. On the other hand, this precious observation, *internal* to Hume's philosophy, however, must not

[2]M. Dal Pra, *Hume e la scienza della natura umana*, Editori Laterza, Rome – Bari 1973, pp. 242–243.

make us forget how this acute and innovative anti-metaphysical and also decidedly anti-spiritualist critical stance, subsequently largely influenced and fertilised the very tradition of critical empiricism of modernity (and also of the neo-positivism that itself originated in the Vienna Circle), by leading to the acceptance, often as taken for granted and acquired, of the existence of a clear and drastic distinction between facts and evaluations, between scientific knowledge and the sphere of the will and passions. In this way, at least in the context of the logical empiricism of neo-positivist origin, the prohibition on drawing moral conclusions from factual premises is configured as a widespread 'common sense', especially in the analytic field, which has systematically enabled philosophers to denounce the traditional metaphysical fallacy of claiming to be able to derive what *ought to be* from what *is*. This has led many authors to denounce the parallel philosophical attempt to found ethics within the realm of knowledge, by thus configuring a clear and drastic dichotomy between facts and values.

This significant theoretical outcome is also clearly explained in the light of the effective history of Western modernity. In fact, on a concrete historical basis, the 'moralistic fallacy', as Giulio Preti understood, for example, is 'typical of every metaphysical foundation of ethics, but is specific to naturalism. In 'nature' we already locate what we want to draw from it—the model of 'nature' itself is constituted according to the ethical model that ought to follow from it'.[3] The emblematic and disruptive historical events of the seventeenth-century doctrine of natural law, especially in its innovative reading produced during the Enlightenment, which historically gave rise to the disruptive French Revolution—the authentic turning point in Western history—constitute a significant and truly emblematic 'test bench' for this complex tradition of thought which, precisely in this drastic dichotomy between facts and values, finally revealed its peculiar historical-critical guillotine by which it subverted, *ab imis fundamentis*, the traditional medieval world to implement, in *the world of praxis*, a revolutionary *civil* entrance to Western modernity (naturally with all its multiple and drastic historical-civil antinomies).

This fundamental and decisive historical context must of course never be disregarded, even when we try to critically understand the *philosophical* nature of this conceptual tradition, by identifying both its intrinsic *values* and its, equally intrinsic, *limits*. Its overall *value* is naturally rooted in the ability to culturally and civilly set free scientific knowledge from any prejudicial metaphysical cage, by releasing, in fact, all the critical potentialities connected with the objective knowledge of the world. Its *limits*, on the other hand, are to be identified within the historical process of the

[3]G. Preti, *Alle origini dell'etica contemporanea. Adamo Smith*, Editori Laterza, Bari 1957, p. 184

Enlightenment—also presenting its complexities—which often ended up by unduly mythologising scientific knowledge itself, by turning particularly its immanent critical nature into a myth, and thus by transforming its inexhaustible criticality (proper and specific to scientific research, which is always open and never concluded), into a dogma and into an altogether metaphysical and absolute reality (in this reconstructive framework post-positivist *scientism* has thus represented, historically speaking, the most widespread cultural and social translation of this myth, which has in fact ended up by elaborating a mythological vision of the scientific enterprise). It is therefore necessary for us to dig into this subtle, but decisive, and at the same time, cultural, institutional, disciplinary and epistemological 'fissure', using the instruments of criticism in order identify a different perspective, capable of freeing all the immanent critical potential of the scientific and objective knowledge of the world, without, however, falling into an undue dogmatic metaphysical mythologisation of science itself and, therefore, of the immanent critical power of knowledge, which is always open and always revisable.

2 Science and life: *Wertfreiheit* and practical-sensitive activities

If science tends to be—and certainly it cannot but tend to be – *wertfrei*, on the contrary, life can never be *wertfrei*, because living means evaluating. In fact, living always necessarily implies, albeit in a broad sense, the ability to *evaluate*. Better still: it should be said that life always implies the capacity of *being able* to evaluate. In this regard, Preti, in *Retorica e logica*, noted that

> To live is to evaluate—already at the most basic biological level, an organism carries out acts of choice: and these, if we broaden the concept of 'evaluation', are already assessments. And anyway, a civilisation without axiological instances does not exist, nor is it conceivable. This is why science can hold the central place in a civilization, but it cannot exhaust it or resolve it totally in its own form.[4]

Therefore, the two cultures, namely the rhetorical-axiological culture and the scientific-objective culture, are so intrinsically correlative and are always necessarily interconnected, *with all due respect to* Hume and his famous 'law' (and also to the misleading dichotomy schematically and erroneously

[4]G. Preti, *Retorica e logica*, new edition, amended and enriched with Introduction and notes by Fabio Minazzi, Bompiani, Milan 2018, p. 408, while the quotation that immediately follows in the text is taken from p. 407.

conceived by Snow in his famous little volume[5]). On the other hand, however, it is also true that

> Science operates with a decisive, methodical, ἐποχή of all the axiological considerations. Science does not evaluate. Even when it is normative, when it is making technology, it only points out ways to follow, possible operational procedures according to the ends-in-view: but it says nothing about the value of these ends themselves; nor, ultimately, about the value of the operating procedures themselves.

From this perspective—admittedly dichotomous—we are therefore faced with two radically different and tendentially antithetical polarities, since science produces objective knowledge which then allows us to consider different operational procedures, also by providing us with a precise critical evaluation of their intrinsic rationality. However, science can never go beyond this specific field, because when we actually choose to follow a certain procedure, by opting out of other possible ones, in addition to scientific knowledge, an axiological evaluation comes into play, which does not pertain to knowledge as such, but to the decisions that concern *our* lives most directly. So much so that in this context different and conflicting axiological evaluations can arise, which can also make certain operational procedures appear as 'more rational' which on the contrary turn out to be 'less rational' at the level of pure objective knowledge, because they might even involve a higher 'cost' (for example when we decide to buy a certain product and/or certain services from a specific provider that charges higher prices than others, but which is more convenient for us or that we choose because it appeals to us more or for various other reasons: personal, historical-biographical, emotional, etc.). Well, in all these cases the 'rationality' of the choice always implies a purely evaluative procedure which systematically goes beyond the level of the mere *Wertfreiheit* of science.

On the other hand, it could also be observed that the very possibility of evaluating always implies, as mentioned, the specific capacity of *being able* to evaluate. In this way the specific relationship between the dimension of knowledge and the dimension of evaluation cannot fail to appear much more problematic and complex than the drastic and controversial dichotomous 'guillotine' of Humean descent could suggest. Conversely on the other hand, it also seems that we cannot give up on the historical-civil *value*, specific to this empiricist dichotomous guillotine devised by Hume, which, as has also been mentioned, has historically acquired undoubted merits, precisely because,

[5]See Charles P. Snow, *The Two Cultures*, first published in 1959 with multiple reprintings, Cambridge, Cambridge University Press. Italian edition: Charles P. Snow, *Le due culture*, translated by Adriano Carugo, *Preface* by Lodovico Geymonat, Feltrinelli, Milan, 1964 with multiple reprintings. Recently this text has been republished by Marsilio (Venice, 2005), without the historical and emblematic *Preface* by Geymonat.

alongside the emotional and concrete historical basis of value, there is also the dimension of objective knowledge. This refers to a demonstrated and argued rational truth, thanks to which a complex patrimony of knowledge has historically been built, which has undoubtedly contributed to improving our overall conditions of life and existence.

How then is it possible to recover all the intrinsic critical value of an objective knowledge of the world without renouncing a critically adequate understanding of the axiological dimension of our own life? The critical link between the axiological dimension and the cognitive one, tendentially *wertfrei*, is therefore configured as much more complex and intrinsically problematic than has ever been suspected by the classical tradition of empiricist descent. Certainly, this connection appears today as worthy of an adequate overall and analytical critical and philosophical rethinking. This was certainly also the intention of various authors, at different time in the history of contemporary reflection. Although it would be impossible here to provide an articulated and exhaustive picture of this interesting critical reflection, nevertheless, I will focus, in particular and with some attention, on the contribution outlined by the great and original American instrumentalist John Dewey.

3 History: which tradition? Herodotus, Hume and Dewey

In *Experience and Nature* Dewey investigated the link between existence and value in detail and in an innovative way, by starting from the awareness both that values 'are what they are', and also from the observation that values are always rooted in the concrete experiences of life, in the world of praxis, thus appearing 'as unstable as the forms of clouds'.[6] Of course, *nihil sub sole novum* (*Ecclesiastes*, 1.10), since already an eminent historian like Herodotus, in the third book of his *Histories* (III, 38, 3–4,), reports this famous episode referring to Darius:

> When Darius was king, he summoned the Greeks who were with him and asked them for what price they would eat their fathers' dead bodies. They answered that there was no price for which they would do it. Then Darius summoned those Indians who are called Callatiae, who eat their parents, and asked them (the Greeks being present and understanding through interpreters what was said) what would make them willing to burn their fathers at death. The Indians cried aloud, that he should not speak of so horrid an act. So firmly rooted are

[6]See J. Dewey, *Experience and Nature*, George Allen & Unwin, London, 1929. The quotations in the text are taken from pp. 396, 399. Italian translation: J. Dewey, *Esperienza e natura*, edited by Piero Bairati, Mursia, Milan 1973, pp. 282–310, quotations which appear in the text are taken from p. 283 and p. 285.

> these beliefs; and it is, I think, rightly said in Pindar's poem that custom is lord of all.[7]

A conclusion, however, reached by Herodotus by having anticipated, in this same passage, that 'if it were proposed to all nations to choose which seemed the best of all customs, each, after examination, would place its own first; so well is each convinced that its own are by far the best.' This is also deeply in keeping with Hume's moderate scepticism, by which, as is well known, man is essentially a *habit-forming animal* since *custom* would always be constitutive of our own experience (although in this specific theoretical context Hume then, paradoxically, misses the intrinsic dynamic value of this very constitutive role of *custom*[8]). But if the frank critical recognition of the absolutely central role played by habits certainly does not eliminate the fruitful and intrinsic critical antinomicity of Hume's position (since Hume, as Dal Pra pointed out, 'is a moralist who prefers instinct to reason' but who, the more he prefers instinct, the more he develops the dimension of reason[9]), on the other hand it does not open at all to any holistic-radical relativism (*à la* Feyerabend[10]), precisely to the extent that our being *habit-forming animals* relates historically, in turn, with the articulated and complex technical-cognitive heritage developed by humanity, *step by step*, in the actual course of its history. Indeed, as Dewey rightly points out, with respect to the values rooted in existence,

> But a brief course in experience enforces reflection; it requires but brief time to teach that some things sweet in the having are bitter in after-taste and in what they lead to. Primitive innocence does not last. Enjoyment ceases to be a datum and becomes a problem.

[7]See Herodotus *The Histories*, translated by A. D. Godley, Loeb Classical Library Edition, Heinemann, London, 4 volumes in Greek and English, originally published 1920–1925, pp. 398–399.

[8]In this regard, Dal Pra rightly observed that, 'Hume, therefore, anticipated Kant's Copernican revolution of the relationship between the subject and the object of knowledge, even if the activity carried out by the subject in the constitution of knowledge explicitly assumes a character not cognitive but instinctive. And the fact that there still remains a significant distance between Hume's position and that of Kant also results from the question that in the analysis of habits Hume tends to minimise the initiative of the subject. In fact, habit is a modality of the subject that almost seems to materialise itself in the pure and simple repetition of several moments of observation; it could be said, with a paradox, that the instinctive modality of the subject is the very result of the observation of the object and that for that aspect of it that more directly calls into question the initiative and the activity, it is more the initiative and activity of 'nature' and of the subject in his awareness. As is well known, Kant understood both the innovation of the Humean doctrine and its limits with great clarity; these coincide, moreover, with the insufficient analysis of the cognitive structures, already noted several times' (M. Dal Pra, *Hume e la scienza della natura umana, op. cit.*, pp. 152–153)

[9]M. Dal Pra, *Hume e la scienza della natura umana, op. cit*, p. 392.

[10]See Paul K. Feyerabend, *Science in a free society*, Verso Editions/NLB, London, 1978. Italian translation by Libero Sosio, Feltrinelli, Milan 1981, pp. 106–129.

> As a problem, it implies intelligent inquiry into the conditions and consequences of a value-object; that is, criticism. If values were as plentiful as huckleberries, and if the huckleberry-patch were always at hand, the passage of appreciation into criticism would be a senseless procedure. If one thing tired or bored us, we should have only to turn to another. But values are as unstable as the forms of clouds. The things that possess them are exposed to all the contingencies of existence, and they are indifferent to our likings and tastes.[11]

Exactly within this precise context of *lived experiences*, then, *criticism*, namely philosophical reflection, plays its own specific and peculiar role. In this case, according to Dewey, we are in fact in the presence of that rhythm of 'flights and perchings' (*à la* James) with which criticism and critical attitude alternate the emphasis on the immediate and the mediated, on what is enjoyed and consumed and on what, on the other hand, is configured as quite instrumental, by focusing on the different phases of conscious experience. In all these cases

> There occurs in every instance a conflict between the immediate value-object and the ulterior value-object: the given good, and that reached and justified by reflection; the now apparent and the eventual. In knowledge, for example there are beliefs *de facto* and beliefs *de jure*. In morals, there are immediate goods, the desired, and reasonable goods, the desirable. In aesthetics, there are the goods of an undeveloped and perverted taste and there are the goods of cultivated taste. With respect to any of these distinctions, the true, real, final, or objective good is no *more* good as an immediate existence than is the contrasting good, called false, specious, illusory, showy, meretricious, *le faux bon*. The difference in adjectives designates a difference instituted in critical judgment; the validity of the difference between good which is approved and that which is good (immediately) but is *judged bad*, depends therefore upon the value of reflection in general, and of a particular reflective operation in especial.

For Dewey, therefore, philosophical reflection can only coincide with this complex operation, and with 'this critical function become aware of itself and its implications, pursued deliberately and systematically'. Moreover, philosophy, starting from evaluative perceptions, behaviours and also from different situations of belief, progressively expands the range of critical reflection precisely to guarantee greater freedom and security to the very acts of direct selection, of rejection or of approval. Thus, Dewey again points out, philosophy

[11] J. Dewey, *Experience and Nature, op. cit.*, p. 398, while all the quotations that follow in the text are taken, respectively, from the following pages: pp. 402–403 (italics in the text), pp. 404–405 (italics in the text); p. 407; p. 410; p. 411; p. 412; p. 414; pp. 420–421; p. 424; p. 428; pp. 428–429; p. 429; p. 430 (italics in the text); p. 434; p. 435; p. 437.

> does not annihilate the difference among beliefs: it does not set up the *fact* that an object believed in is perforce found good as if it were a *reason* for belief. On the contrary: the statement is preliminary. The all-important matter is what lies back of and causes acceptance and rejection; whether or no there is method of discrimination and assessment which makes a difference in what is assented to and denied. Properties and relations that *entitle* an object to be found good in belief are extraneous to the qualities that are its immediate good; they are causal, and hence found only by search into the antecedent and the eventual. The conception that there are some objects or some properties of objects which carry their own adequate credentials upon their face is the snare and delusion of the whole historic tradition regarding knowledge, infecting alike sensational and rational schools, objective realisms and introspective idealisms.

4 Ontological essences or transductive interactions?

Moving within this precise horizon of thought, Dewey therefore seeks to critically overcome all the traditional and multiple 'mental cramps' (*à la* Wittgenstein) specific to the different philosophical traditions (empiricist, rationalistic, realistic and idealistic), to put his eminently *critical* attitude at the centre of philosophical reflection, in order 'to make it clear that there is no such difference as this division assumes between science, morals and aesthetic appreciation'. In this way Dewey means to underline the critical inadequacy of the traditional dichotomy between facts and values, between knowledge and morals, by aiming at recovering a much more articulated, critical and fruitful horizon of reflection. According to Dewey, it is therefore necessary to be able to critically dismantle the difference, both metaphysical and ontological, which one imagines exists between science, morality and aesthetics, since 'in a moving world solidification is always dangerous'.

In this precise critical context, the role of philosophy consists not so much in competing with science to conquer truth, but in succeeding at 'liberating and clarifying meanings, including those scientifically authenticated'. Operating within this perspective horizon, it is therefore necessary to have the courage to place 'social reform' itself outside an excessively narrow and 'Philistine' context, since it has instead to be reconnected precisely with the 'liberation and expansion of the meanings of which experience is capable'. In short, it is necessary to know how to recapture the concept of 'the richest and fullest experience possible' and then, in this exact perspective, the specific contribution historically provided by philosophy, with its privileged work of conceptual clarification, is rooted precisely in the thorough analyses produced by criticism, in order to be able to recover the complexity and multiplicity of all the interactions that always qualify, structure and characterise human life. Just because 'man needs the earth in order to walk, the sea to swim or

sail, the air to fly. Of necessity he acts within the world, and in order to be, he must in some measures adapt himself as one part of nature to other parts.' Through this progressive and always dynamic 'adaptation' it is then possible to discover the *multiplicity of interactions* that human beings build up in the course of their existence, without falling into the metaphysical trap of the ontologisation of the relations codified in the classic tradition of *ens, verum et bonum*, which constituted an absolute metaphysical object, conceived as coincident as a real and existential metaphysical entity. Again for this reason it is necessary, then, *to know how to* critically *rebuild* our own experience, without however, on the one hand, ever expecting to be godlike, and, on the other hand, without becoming disillusioned with a world which would systematically disappoint us. If anything, for Dewey

> a mind that has opened itself to experience and that has ripened through its discipline knows its own littleness and impotencies; it knows that its wishes and acknowledgments are not final measures of the universe whether in knowledge or in conduct, and hence are, in the end, transient. But it also knows that its juvenile assumption of power and achievement is not a dream to be wholly forgotten. It implies a unity with the universe that is to be preserved. The belief, and the effort of thought and struggle which it inspires are also the doing of the universe, and they in some way, however slight, carry the universe forward. A chastened sense of our importance, apprehension that it is not a yard-stick by which to measure the whole, is consistent with the belief that we and our endeavours are significant not only for themselves but in the whole.
>
> Fidelity to the nature to which we belong, as parts however weak, demands that we cherish our desires and ideals till we have converted them into intelligence, revised them in terms of the ways and means which nature makes possible. When we have used our thought to its utmost and have thrown into the moving unbalanced balance of things our puny strength, we know that though the universe slay us still we may trust, for our lot is one with whatever is good in existence. We know that such thought and effort is one condition of the coming into existence of the better. As far as we are concerned it is the only condition, for it alone is in our power. To ask more than this is childish; but to ask less is a recreance no less egotistic, involving no less a cutting of ourselves from the universe than does the expectation that it meet and satisfy our every wish. To ask in good faith as much as this from ourselves is to stir into motion every capacity of imagination, and to exact from action every skill and bravery.

In this way Dewey delineates the median position of human beings, by which, at the very moment when they assert that their power is limited, as beings that belong entirely to nature, of which they represent a moment and on which they always depend, nevertheless we can also affirm, with a

'chastened sense of our importance', our own *constructive* role which can even push the universe itself forward a little. Human beings must therefore know how to take part, consciously and critically, in the processes of natural reality themselves, by building, in the words of the sociologist Boaventura De Sousa Santos, a sort of articulated 'ecology of knowledges',[12] by means of which we can never forget the *infinite plurality of interactions* within which human beings can perform their actions and develop their critical reflection. This then led Dewey to critically rethink the link between *belief* and *knowledge* by breaking the traditional empiricist rigidity of this dichotomy. Indeed, if knowledge has generally been conceived as 'pure objectivity', by attributing to it the role of controlling belief through knowledge, science and truth, Dewey, on the contrary, emphasised that this dichotomy itself, which is integral to the Western tradition of philosophy, has to be critically rethought, starting from the epistemological awareness that knowledge itself constitutes, in its turn, 'a case of belief'. For this reason it is therefore necessary to decisively turn our backs on the traditional empiricist theory, totally mythological and metaphysical, according to which our knowledge draws inspiration from 'innocent sensory data, or from pure logical principles, or from both together, as original starting points and material.' Indeed according to Dewey

> All knowing and effort to know starts from some belief, some received and asserted meaning which is a deposit of prior experience, personal and communal. In every instance, from passing query to elaborate scientific undertaking, the art of knowing criticises a belief which has passed current as genuine coin, with a view to its revision. It terminates when freer, richer and more secure objects of belief are instituted as goods of immediate acceptance. The operation is one of doing and making in the literal sense. Starting from one good, treated as apparent and questionable, and ending in another which is tested and substantiated, the final act of knowing is acceptance and intellectual appreciation of what is significantly conclusive.

But then, Dewey wonders: 'Is there any intrinsic difference between the relation of scientific inquiry to belief-values, of aesthetic criticism to aesthetic values, and of moral judgments to moral goods? Is there any difference in logical method?'

His answer to this question is on the whole negative, precisely because the evaluation of any belief-value always implies a *comparative* judgment, since, when we affirm that an object 'is good', this may perhaps appear as an absolute statement, especially when it is formulated in the context of

[12] See Boaventura De Sousa Santos, *A cruel pedagogia do vírus*, Boitempo Editorial, São Paulo, 2020. Italian translation: *La crudele pedagogia del virus*, translated by E. Vitello, Castelvecchi, Rome 2020.

action and not so much in the context of reflection. However, this affirmation about the goodness of a given reality is always the result of a comparative process which, in turn, refers to an evaluative comparison exactly because in these cases 'the issues shift to something comparative, relational, causal, intellectual and objective':

> *Immediately* nothing is better or worse than anything else; it is just what it is. Comparison is comparison of things, things in their efficacies, their promotions and hindrances. The better is that which will do more in the way of security, liberation and fecundity for other likings and values.

From this dynamic, interactive and implicitly *transductive*[13] perspective Dewey is, therefore, able to outline a coherent overall conception of a human being, who no longer qualifies as a sort of 'little god', but who instead fully recognises that humanity belongs to nature as a centre of energy that is always interconnected with multiple other centres of interaction and energy. The Western philosophical tradition from Descartes onwards has considered nature as a kind *alter ego* in relation to ourselves, which would qualify precisely for its absolute otherness and for its overall intrinsic passivity. On the contrary, from this new instrumentalist and transductive point of view, Dewey re-evaluated Spinoza's position, without ever referring to it explicitly, as well as that of the American Indians, according to whom human beings actually constituted a part, albeit infinitesimal, of nature. It is therefore necessary to start from this 'intrinsicity' between man and nature, an 'intrinsicity' which considers humans as a purely natural element, devoid of any exceptionality in the context of naturality. Dewey wrote:

> When man finds he is not a little god in his active powers and accomplishments, he retains his former conceit by hugging to his bosom the notion that nevertheless in some realm, be it knowledge or aesthetic contemplation, he is still outside of and detached from the ongoing sweep of inter-acting and changing events; and being there alone and

[13]For the concept of transductivity developed by Dewey it is naturally necessary to refer to the chapter 'Interaction and Transaction' from *The Later Works of John Dewey, 1925–1953*. Volume 16: 1949–1952 *Essays, Typescripts and Knowing and the Known*, written in collaboration with Arthur F. Bentley edited by Jo Ann Boydston, Southern Illinois University Press, Carbondale, 1989/2008, in particular p. 97, where it is specified that 'What we call 'transaction' and what we wish to show as appearing more and more prominently in the recent growth of physics, is, therefore, in technical expression, neither to be understood as if it 'existed' apart from any observation, nor as if it were a manner of observing 'existing in a man's head' in presumed independence of what is observed. The 'transaction', as an object among and along with other objects, is to be understood as unfractured observation—just as it stands, at this era of the world's history, with respect to the observer, the observing, and the observed—and as it is affected by whatever merits or defects it may prove to have when it is judged, as it surely will be in later times, by later manners' (p. 97).

> irresponsible save to himself, is as a god. When he perceives clearly and adequately that he is within nature, a part of its interactions, he sees that the line to be drawn is not between action and thought, or action and appreciation, but between blind, slavish, meaningless action and action that is free, significant, directed and responsible. Knowledge, like the growth of a plant and the movement of the earth, is a mode of interaction; but it is a mode which renders other modes luminous, important, valuable, capable of direction, causes being translated into means and effects int consequences.

In this way the absolute empiricist dichotomy between facts and evaluations, between knowledge and evaluations is undoubtedly overcome critically by elaborating the model of the transductive interaction which, as we have seen, even assumes the growth of a plant as a heuristic-paradigmatic model to analyse critically the complex interaction between human life and the knowledge of the world itself. The model of the biological growth of plants makes it possible to highlight how growth itself takes place through a continuous critical metabolisation that transforms the inorganic into the organic, ensuring that a plant is in fact able to build the environment in which it lives by interactively *building* its own context as well as by interacting with it. Through this fruitful and innovative approach, the traditional way of understanding the function of philosophy itself also changes, since Dewey consequently conceived 'philosophy as the critical method of developing methods of criticism'. On the one hand, this constituted a fecund revival of the tradition of Western criticism already outlined by Socrates in the fifth century BCE; on the other hand, it referred to a new critical-epistemic paradigm in the name of which the increase of objective knowledge must be capable of explanation by the interactions of multiple transductive-transactions that also qualify the mode of growth of a plant and a vegetable.

5 The new perspective of Husserlian phenomenology

In the light of Dewey's critical considerations referred to in the previous paragraph, it is clear that what is called Hume's law has undoubtedly lost much of its heuristic éclat and its original methodological absoluteness. Not so much because the distinction between facts and values may appear today 'hopelessly fuzzy, because factual statements themselves, and the practices of scientific inquiry upon which we rely to decide what is and what is not a fact, presuppose values'[14], since this observation constitutes, in reality, a well-known and somewhat discredited critical stance. If anything, because, as Hilary Putnam added, referring to both W. James and A. E.

[14]Hilary Putnam, *Reason, Truth and History*, Cambridge University Press, Cambridge, 1981, p. 128. (Italian translation *Ragione, verità e storia* by Alessandro Nicolò Radicati di Brozolo, edited by Salvatore Veca. Il Saggiatore, Milan 1985, p. 140).

Singer, '*Knowledge of facts presupposes knowledge of values*' and, conversely '*Knowledge of values presupposes knowledge of facts'*.[15] It is therefore necessary to critically investigate this connection by identifying, if possible, a different critical path. To do this, we need to go back to the *moralistic fallacy* to which we referred earlier by pointing out how the naturalists of the eighteenth century inspired by the Enlightenment fell into it precisely to the extent that into their concept of 'nature' they inserted whatever they wanted ... to obtain from it. In this case, as we have seen, the very model of 'nature' is constructed, as Preti pointed out, 'according to the ethical model that should be its consequence'. We are thus faced with an obvious *vicious circle*. The indisputable historical fact that precisely this vicious circularity constituted, through the French Revolution, the historical-civil leaven of modernity certainly does not constitute its philosophical justification. If anything, it is only a very important *de facto* datum which, however, does not nullify the unconvincing logical argument that claims to 'be the foundation' of this same vicious circularity. Precisely in order to overcome this critical impasse, which is both logical and historical, the more mature reflection developed during the Enlightenment by Rousseau and Kant finally developed a philosophically shrewder and more sophisticated naturalism. As Preti further observed, beyond the appeal to 'nature' or to 'reason', what appeared essential in this critically more mature reflection created during the Enlightenment is that

> a pure a priori ideal principle is invoked, which at the same time constitutes the foundation and limit of the historical-empirical variations of morals and of opinions about ethics. This supreme norm of conscience, as universal and necessary, faces contingent manifestations: it is a *critical* principle, in the face of which every norm and empirical evaluation, with its limitation, shows its arbitrariness and historical contingency. No norm stands up to the criterion of reason.'[16]

On the other hand, from this supreme *ideal* criterion of reason one can naturally deduce no particular norm, no right and therefore, also no particular system of values, no positive morality, no kind of catechism. If we do it, we fall back into the *moralistic fallacy*. It is therefore definitely crucial to reflect on the role and function of this *ideal* criterion of reason by addressing what has been considered the problem of the place of reason in ethics. But, more generally, it is necessary to question the intrinsic nature of human critical rationality as such. For this reason it is imperative to investigate what human rationality consists of.

[15] Hilary Putnam, *The Collapse of the Fact-Value Dichotomy and Other Essays*, Chapter 8 'The Philosophers of Science's Evasion of Values', Harvard University Press, Cambridge, Massachusetts and London, England, 2002, p. 137, italics in the text.

[16] G. Preti, *Le origini dell'etica contemporanea. A. Smith*, op. cit., p. 185.

In the first place, it could be observed how human reason coincides with *logical coherence*, by thus formulating an answer that refers merely to the *formal* dimension of human rationality. Indeed, logic does not concern only and exclusively the cognitive discourse, but rather it relates, and not only potentially, to any type of possible discourse that can be formulated, in a coherent way, in any field of investigation and reflection. But the formal transversality of this answer reveals its limits, because in this case we are dealing with a purely *formal* rationality, which can certainly make any argument 'rational' (hence also evaluative arguments), but it does not enter into the merits of rationality as such. In fact, this approach, precisely because of its formal limitation, does not make it possible to consider purely evaluative discourse as rational. Indeed, it seems to increase the traditional contrast between the intrinsic rationality of theoretical discourse and the equally intrinsic irrationality of evaluative discourse. However, precisely in relation to this contrast, it would then be worth mentioning an important critical achievement of Hume's, on the basis of which we know that human reason can only *order* the contents on which it reflects, but it can never *create them*. This observation is valid not only for the evaluative field, but also for the theoretical-cognitive field. In every different area of investigation, 'data' are always made available through reason but never produced by it. From this point of view, the ultimate contents of evaluations (attitudes and emotions) are then just as 'irrational' as the 'sensible data' (sensations) that underpin knowledge.

However, if we dismiss this first answer, which insists on the *logical formality* of reason, another sense of rationality can be evoked, which is specific to the typical idea of rationality developed during the Enlightenment and which is related to the logical and methodical reflection concerning what Galilei referred to as 'sensible experiences', i.e., our objective scientific knowledge. As Preti wrote

> The only 'rationality' (in this second sense) of the evaluative discourse lies in the rationality of its cognitive moment, of its motivations. The only disagreements that can be rationally resolved are disagreements of belief. The proof that the accused did not commit the act removes all sense from the discussion about the juridical configuration of the alleged crime.[17]

This has a specific significance, since 'a traditional system of evaluations can be challenged not only by changing attitudes, but also, and more irremediably, if its system of motivations is theoretically false; that is, if science declares it erroneous. The case of witches, although a borderline case, shows very clearly what I mean'.

[17] G. Preti, *Retorica e logica*, op. cit., p. 415, from which the immediately following quotation is also taken.

6 Theoretical disciplines as foundations of normative disciplines

Precisely this different approach to the critical understanding of human rationality makes it possible to perform a significant critical overturning of the traditional empiricist approach, which affirms the existence of an irreducible dichotomy between facts and evaluations. Indeed, if the traditional Humean distinction associated with 'Hume's law' leads us to believe that there is no direct link and no possible critical mediation between facts and evaluations, as well as between knowledge and attitudes, the new phenomenological framework outlined by Edmund Husserl enables us, on the contrary, to affirm that, in reality, precisely the opposite is true, since every evaluative judgment is always rooted in a cognitive judgment. In other words, to quote Husserl, every predicate of value, i.e., every evaluative one, must be considered as 'second-order' predicates, or rather as 'predicates of predicates'. In this perspective, to refer directly to the Husserlian *Logical Investigations*, 'theoretical disciplines' are configured 'as the foundation of normative disciplines.'[18] Husserl critically attacked the traditional empiricist (pre-)judgement on the basis of which facts and values do not present any binding relationship, as they are set within an absolute dichotomy, devoid of mediations and, therefore, completely unrelated. On the contrary, Husserl believed that theoretical disciplines themselves constitute the authentic 'foundation' of normative disciplines. In other words, for Husserl every axiological judgment is always rooted in precise, historically determined and configured cognitive assets. To clarify this innovative point of view, Husserl states, first of all,

> The concept of a normative science in relation to that of a theoretical science. The laws of the former tell us (it is usually held) what shall or should be, though perhaps, under the actual circumstances, it neither is nor can be. The laws of the latter, contrariwise, merely tell us what is.

But what is meant by *should be* in comparison to the simple *be*? What is being stated, when it is argued that a 'soldier should be brave' or that a 'teacher should be qualified' or that 'a sportsman must be trained' or that 'parents must look after their children with love and intelligence' or, again, that 'a doctor must be a good clinician'? Well, Husserl observes,

[18] E. Husserl, *Logical Investigations*, International Library of Philosophy, edited by Jose Bermudez, Tim Crane and Peter Sullivan, translated by J. L. Findlay from the Second German edition of *Logische Untersuchungen* with a new Preface by Michael Dummett and edited with a new Introduction by Dermot Moran, Routledge, London & New York, 1970/2001, 3 vols. Vol. I, *Prolegomena to Pure Logic*, p. 28 and following quotations appearing in the text are taken from pp. 33–34; p. 35 (italics in the text); p. 36; pp. 36–37 (no italics in the text); p. 37; p. 38 (no italics in the text; texts between both square and round brackets not present in the English text); p. 39;

> In all these cases we make our positive evaluation, the attribution of a positive value-predicate, depend on a condition to be fulfilled, whose non-fulfilment entails the corresponding negative predicate.

In short: 'An A should be B' and 'An A that is not B' can only be 'a bad A', precisely because, more generally, 'only an A which is a B is a good A'. This is the general inferential scheme that is used in axiology, which then explains the overall equivalence of the following sentences: 'an A that is B is in general a bad A', 'an A should not be B'; or, again, 'only an A that is not B is a good A'. A cowardly soldier is a bad soldier, just as an unqualified teacher is a bad teacher, as parents unable to take care of their children with love and intelligence are bad parents, as a doctor without clinical knowledge is a bad doctor. To affirm that a soldier should not be cowardly, that a teacher should not be unqualified, that parents should not look after their children without love and intelligence, and that a doctor should not lack a clinical eye, does not, however, imply the falsity of the statement according to which a cowardly soldier is also a bad warrior or that an unqualified teacher is also a bad teacher or, again, that parents unable to take care of their children with love and intelligence are bad parents or that a doctor lacking a clinical eye is a bad doctor. Judgments that relate to *should*, in fact, do not imply any statement about a correspondent *be*, precisely because, logically speaking, a duty and the lack of duty, at least on a logical-formal level, are always mutually exclusive.

> We see from these analyses that each normative proposition presupposes a certain sort of valuation or approval through which the concept of a 'good' or 'bad' (a value or a disvalue) arises in connection with a certain class of objects: in conformity with this, objects divide into good and bad ones. To be able to pass the normative judgement 'A soldier should be brave', I must have some conception of a 'good' soldier, and this concept cannot be founded on an arbitrary nominal definition, but on a general valuation, which permits us to value soldiers as good or bad according to these or those properties. Whether or not this valuation is in any sense 'objectively valid', whether we can draw any distinction between the subjectively and objectively 'good', does not enter into our determination of the sense of should-propositions. It is sufficient that something is held valuable, that an *intention* is effected having the content that something is valuable or good.

From Husserl's perspective on the basis of these considerations a normative proposition can then be defined as that particular proposition which, in relation to a previous general axiological assumption, which stands as its foundation, by determining a correlative pair of value predicates, is capable of expressing the conditions (necessary or sufficient or also, at the same time, necessary as well as sufficient) for the possession of a given predicate:

> If we have once drawn a distinction between 'good' and 'bad' in our valuations in a particular sense, and so in a particular sphere, we are naturally concerned to decide the circumstances, the inner or outer properties that are or are not guarantees that a thing is good or bad in this sense: what properties may not be lacking if an object from that sphere is to be accorded the value of 'good'.

In this way it is possible to construct an articulated hierarchy of axiological judgments which refer to a fundamental norm, by configuring a set of norms that form a closed and independent group, which in the end is determined and qualified precisely by the axiological assumption judged as fundamental. Precisely this general normative proposition will consequently force the entities of a given sphere to adapt as far as possible to the specific and constitutive characteristics of the predicate axiologically assumed as positive and fundamental, which generates, precisely, the general norm of that specific group of norms. In this perspective

> The basic norm is the correlate of the definition of 'good' and 'bad' in the sense in question. It tells us on what *basic standard or basic value* all normativisation must be conducted, and does not therefore represent a normative proposition in the strict sense. The relationship of the basic norm to what are, properly speaking, normative propositions, is like the relation between so-called definitions of the number-series and the arithmetical theorems about the relations of numbers which are always referred back to these. The basic norm could also be called a 'definition' of the standard conception of good—e.g., of the morally good—but this would mean departing from the ordinary logical concept of definition.

In any case the idea of a *regulatory discipline* arises just from the totality of the connections existing between different normative propositions. This central and decisive reference for normative disciplines is instead absent in theoretical disciplines, for which the overall unity of their investigations is rooted in the possibility of identifying what arises from the 'inner laws of things', within their 'mutual coherence'. But, as mentioned, for Husserl theoretical disciplines are configured as the authentic foundations of normative disciplines:

> Every normative proposition of, e.g., the form 'An A should be B' implies the theoretical proposition 'Only an A which is B has the properties C', in which 'C' serves to indicate the constitutive content of the standard-setting predicate 'good' (e.g.. pleasure, knowledge, whatever, in short, is marked down as good by the valuation fundamental to our given sphere). The new proposition is purely theoretical: it contains no trace of the thought of normativity. If, conversely, a proposition of the latter form is *true*, and thereupon a novel valuation of a C

> as such emerges, and makes a normative relation to the proposition seem requisite, the theoretical proposition assumes the normative form 'Only an A which is B is a good A', i.e. 'An A should be B'. Normative propositions can therefore make an appearance even in theoretical contexts: our theoretical interest in such contexts attaches value to the being of a state of affairs of a sort—to the equilateral form, e.g., of a triangle about to be determined—and then assesses other states of affairs, e.g. one of equiangularity, in relation to this: If the triangle *is to* [*sollen*] be equilateral, it *must* [*müssen*] be equiangular.

However, in the theoretical sphere, Husserl points out again, this possible reformulation carried out through normative propositions is not essential, because in the cognitive field the ultimate and constitutive intention of theoretical reflection is rooted in the possibility of identification based 'on the theoretical coherence of the things themselves' and for this specific reason 'enduring results are not therefore stated in normative form, but in the forms of this objective coherence, in the form, that is, of a general (*generell*) proposition'. In this way Husserl produces a critical overturning not only of the traditional dichotomy between facts and values, connected with the "law of Hume", but also succeeds in criticising the classic epistemological setting of empiricism itself by overturning its terms of reference. Indeed, if the empiricist believes he can justify a specific axiological judgment by appealing to experience, on the contrary the critical perspective inaugurated by Husserlian phenomenology reminds us how each of our axiological judgments is always rooted within precise and determined *cognitive assets*. Thus, according to the traditional empiricist approach, a particular class of students will be judged by its teachers as more or less 'good', or as more or less 'bad', in regard to the *experience* of teaching as gained within this particular group of students. In this way empiricism ends up by discharging the overall responsibility of the axiological judgment on the experiential level, conceived as neutral and, basically, as completely passive: the teacher limits himself to objectively recording the 'good' or 'not-good' quality of a class as such. From this perspective, the teacher, as an evaluator, does not perform any specific role because, in fact, he would limit himself to recording, with objectivity and impartiality, the actual and real condition of that particular class.

On the contrary, the phenomenological perspective makes us notice how teachers, at the very moment when they formulate their axiological judgments in relation to a group of students, in reality do not limit themselves at all to considering their first-hand teaching experience within a class-group in a neutral and passive way, since in formulating their judgments they refer to a precise cognitive model (heuristic and paradigmatic) on the basis of which, even before meeting a specific class, they know very well what 'a good class' is in comparison with 'a bad class'. Therefore, their final axiological

judgments do not arise from pure experience, but from a precise comparison of their prejudicial heuristic-cognitive models with the actual experience they make in teaching a specific class.

This is true, more generally, of all our axiological judgments, since all our evaluations are always rooted within a precise and previous theoretical-cognitive horizon. This makes it possible, then, in the first place, to critically highlight the *gnoseological* responsibility itself of all our axiological judgments that do not arise from passive experience but are the result of an interrelation between our knowledge and our experience. And this is not all: in the second place, this critical horizon configures a much more complex and dynamic relationship, of continuous transductive interrelation, between the evaluative and the cognitive purviews. Knowledge and evaluation are by no means unrelated, rather they affect each other, within the very complexity of experience, which must then be critically unravelled, by understanding the heuristic role exercised by the paradigmatic models of knowledge that we use to construct our experience. Indeed experience, *by itself*, never teaches us anything, if we do not know how to read it, how to interpret it, how to understand it and explain it in the light of a particular theoretical perspective. In the third place and finally, the Husserlian perspective allows us to understand how the development of our technical-cognitive assets necessarily always also have a precise axiological effect, by removing both from human knowledge and from axiology the supposed metaphysical claim that knowledge and axiology can develop in an ahistorical, immutable, absolute dimension, indifferent to the history of human knowledge. On the contrary, it is precisely the intertwining and always changing dynamic between the critical development of our knowledge and the equally mobile and dynamic dimension of our own moral and axiological reflection, which configures a much more articulated and complex life situation, precisely because, as Husserl explicitly writes,

> Every normative discipline demands that we know certain non-normative truths: these it takes from certain theoretical sciences, or gets by applying propositions so taken to the constellation of cases determined by its normative interest. This naturally holds, likewise, in the more special case of a technology, and plainly to a greater extent. The theoretical knowledge is there added which will provide a basis for a fruitful realization of ends and means.

From a certain point of view Husserl performed this critical overturning of the traditional empiricist approach by highlighting the *active* critical and epistemological connection, which is also rooted, as already mentioned (see the previous note 8), within repetitiveness itself, apparently neutral and totally passive, triggered by the Humean concept of *custom*. In fact the apparently passive stratification of human experience itself, from which habit

ultimately arises, constitutes, *despite itself*, an *active* element through which experience definitely loses that character of total passivity theorised by Hume from the very first pages of *A Treatise of Human Nature*, to configure, albeit *in a nutshell*, precisely that decisive and strategic 'Copernican revolution' that was later theorised and articulated by Kant in his *Critique of Pure Reason* with the heuristic introduction of the concept of the *transcendental* as a privileged hermeneutic tool, aiming at a better understanding of the inferential deductive nature of human knowledge itself, which was affirmed with the birth of modern science thanks to Galilei and Newton.[19] Which is then also related to a similar need with which the more mature reflection developed during the Enlightenment finally emancipated itself from the *moralistic fallacy*, typical of the doctrine of natural law, by directly appealing to a pure *a priori* and ideal principle which constitutes, as has also been mentioned, the limit and the foundation of the historical-empirical variations of the customs and ethos of a specific historical society. This 'parallelism' between the critical maturation of Kantian transcendentality in a purely epistemological context, and the parallel need of being able to identify the role and function of an ideal principle within the continuous historical variability itself of human events (for which see § 3), then confirms precisely the historical existence of the interconnection between theoretical and normative disciplines, with the former as the foundations of the latter.

7 A new image of the objectivity of knowledge

The new Husserlian conception of the relationship existing between theoretical and normative disciplines is based, in turn, on the overall perspective of Husserl's phenomenology, which started from a critical re-evaluation of the correlation between subject and object in order to highlight ideal purely theoretical truths and their heuristic role within knowledge. Again in this case the stance adopted by phenomenology constitutes a radical critique of traditional empiricism. Nor is that all: from his phenomenological perspective, Husserl also started a radical critical discussion of the previous, traditional metaphysical approach, which relied, alternatively, either on a subject conceived as absolute (consider the tradition of ideal realism, from Plato to Hegel), or, and conversely, on an object conceived in an equally absolute and metaphysical way (in accordance with the metaphysical realism specific to materialism, from Democritus to La Mettrie).

Husserl, referring in a completely original and innovative way to Kantian transcendentality, pluralised it, by identifying multiple *planes of reflection* within which and according to which the different disciplines are constituted.

[19] In relation to this decisive epistemological theme, I refer to my book, in press, *L'epistemologia storico-evolutiva e il neo-realismo logico. (Historical-evolutionary epistemology and logical neo-realism)*.

In this perspective, Husserl maintained and preserved the structure of *intentionality* specific to the Kantian transcendental, according to which both the traditional absolute metaphysical idealism as well as the traditional absolute and metaphysical realism were *critically* undermined because, instead of referring to unrelated and absolute ideals, or to realities, equally unrelated and absolute, the focus of the investigation was the specific link established by a correlation between the subjective but empty intentionality with which one addresses the world and the effective capacity that the real world (Kant's empirical reality) possesses in being able to possibly 'saturate', albeit to different degrees of saturation, that prospective intentionality itself. From this transcendentalist phenomenological perspective, the conception of scientific knowledge as well as that of the world of praxis changed profoundly. Indeed, as Preti observed, seen in this perspective,

> the 'world', whose framework is constructed by scientific knowledge is a system of objects—and these objects are *noemata* of the first degree, in whose constitution there are no categories (predicates) of value. The world of science is neither beautiful nor ugly, neither good nor bad: the attitude of scientists, as such (at the moment when they are such, and they remain such) is that of belonging to the ascetic ataraxia of the Stoic-Spinozian wise person. For this reason, Scheler is right to say that a human being (as the being who develops science) 'is the ascetic of life'.
>
> But this is not the attitude of life—of any living being, of any person; it cannot even be the definitive attitude of the scientist, or of the philosopher, as a person-who-lives. Life is praxis, and the world of life is a world of values. It is made up of things that are *noemata* of the second order, they are 'good things' (or 'bad things'); it is made up of actions, and works, which aim at realising values, by turning them into facts and things'.[20]

However, Preti's approach here seems to reaffirm the existence of an underlying dichotomy between the world of knowledge (theoretical truth) and the world of life (evaluation and value). Indeed, Preti himself, in *Retorica e logica*, albeit for many and different reasons, always strongly confirmed this dichotomy, although, as emerges also from this quotation, he did not overlook the strategic importance of the new phenomenological approach to the problem of knowledge and the question itself of the normative disciplines. In fact, from the quotation just given, it emerges that the 'world', in both the theoretical and the practical sphere, always constitutes a universal and complex set of relationships which, in the theoretical sphere, focuses precisely on the elements of knowledge (what we have indicated as the

[20]G. Preti, *Retorica e logica*, op. cit., pp. 427–428, while the quotation immediately following in the text is taken from p. 449.

technical-scientific assets available to each specific society), while in the context of praxis the 'world' refers, instead, to a particular and specific set of axiological connections. This should not lead us to forget, as Preti himself never forgets (I will borrow his words again), that

> the axiological culture, by its motivations, by the practical plans themselves that it implies in its tendency to implement values by bringing them into existence, relies on scientific culture: and an axiological picture of the world always presupposes a scientific picture of existence (of nature, history, etc.). The non-coincidence of the picture of the world used by axiological culture with that presented by science produces a historical crisis of civilisation, and therefore represents a dynamic element of change (I always speak within civilisation, that is, on the ground of the reflected cultural life).

It is therefore necessary to focus our attention now on these elements, because these two 'worlds', if they refer to the overall history of the Western tradition, are configured just like the two real 'engines', both privileged and indispensable, *within which* and *thanks to which*, our history has on the whole developed through the centuries. Furthermore, these two different worlds (the theoretical and the axiological) within them present quite peculiar dynamics, which must therefore be studied and comprehended in their specific (albeit relative) autonomy. Thirdly and finally, last but not least, as we have seen, these two 'worlds' also have their own specific and fruitful interrelation, of which a progressive critical awareness has been reached to the extent that the rigid dichotomy between facts and values has been progressively challenged, discussed and criticised, to the point that, by Husserl, its privileged and absolute value was overturned, while this dichotomy was transformed into a flexible heuristic tool for the critical understanding of Western history and of our own human condition. Which then also helps us to understand the legitimacy itself with which an author like Preti has in any case decided to hold firmly to the empiricist dichotomy between theoretical disciplines and the axiological world, by electing it as his privileged heuristic tool to better investigate the developments of the 'two cultures' (the logical-scientific and the axiological) within Western history. As can easily be perceived even from these few considerations, the problem faced is by no means simple and therefore deserves to be analysed critically, with all due caution.

The fundamental point, as I see it, seems to be to recognise, with Husserl, that scientific knowledge constitutes, as we can find again in his *Logical Investigations*, 'purely theoretical truths, ideal in character, rooted in their own semantic content and not straying beyond it. They can accordingly not be affected by any actual or imagined change in the world of *matter of fact*.'[21]

[21] E. Husserl, *Logical Investigations*, op. cit., Vol. I, p. 97 (no italics in the text). The quotations that follow in the text are taken from the following pages, again from the first

In this the whole critical distance that exists between the phenomenological and empiricist approaches re-emerges. From this point of view, in fact, the heart of scientific knowledge is not rooted in experience, nor is it possible any longer to conceive scientific knowledge as a product of experience. On the contrary, the value of scientific knowledge is instead rooted in those 'purely theoretical truths, ideal in character' which are formed precisely within the ambit of *meaning* without ever transcending it. If a human being defined by empiricism is a person who learns from experience, for Husserl, on the contrary human beings learn only by virtue of their own critical intelligence, with which they challenge, question and interpret the world, even that of experience, through *open meanings* by means of which *intentionality* strives to identify *ideal laws* capable of pointing out *objective links between things*. This naturally also implies a very different kind of anthropology, since for Husserl it is evident that the superiority of human beings over other living forms is based on their intelligence itself:

> Man's superiority lies in his intelligence. He is not solely a being who brings perception and experience to bear on external situations: he also thinks, employs concepts, to overcome the narrow limits of his intuition. Through conceptual knowledge he penetrates to rigorous causal laws, which permit him to foresee the course of future phenomena, to reconstruct the course of past phenomena, to calculate the possible reactions of environing things in advance, and to dominate them practically, and all this to a vastly greater extent, and with vastly more confidence, than would otherwise be possible. *Science d'ou prevoyance, prevoyance d'ou action*, as Comte tellingly remarks. Whatever misery the one-sidedly overstrained yearning to know may bring to the individual thinker, and that not seldom, the fruits, the treasures of science ultimately accrue to the whole of humanity.

Science, which has ideal truths as its privileged content, therefore originates by an effort of thought and ideas with which we are able to reflect in an innovative—today we would say counterfactual—way on the world of experience itself. This accentuation of the role of ideas, thoughts and intelligence in no way negates the value and function of experience, only it places the function of experience not at the beginning of knowledge, but at the always fundamental moment of its experimental verification. From this perspective, Husserl's vision comes clearly into conflict with the traditional Baconian image of science, according to which scientific knowledge is rooted, *primarily*, in the context of the sense experience of the world. On the other hand, for Husserl, as already for Kant, scientific knowledge cannot even be

volume: p. 125 (italics in the text); p. 119; p. 113; p. 112; pp. 130–131 ('not' and 'its' in italics in the text, the other italics are mine); p. 132 (no italics in the text); p. 133; p. 149 (italics in the text).

configured, if we do not understand the fundamental heuristic role played by human intelligence, by our ability to succeed in challenging the world in the light of some ideal truths with which we test our ability to understand the objective links between the things of the world. Of course, due to the phenomenological correlativity that exists between subject and object, it is not possible to "attribute" the cognitive capacity of knowledge to the ideal component alone. In fact, if the latter can actually elaborate, by means of *meanings*, an *ideal* understanding of the world, it is then necessary to submit this merely ideal explanation of the world to a check, to a verification, and also to a possible falsification. But this decisive experimental check is no longer configured *near the source* of science, but *near the conclusion* of scientific inference. Consequently, the constitutive inference of scientific reasoning is no longer the *inductivist* one variously theorised by almost every empiricism of modernity (including the anti-metaphysical verification principle of twentieth-century logical empiricism), but the one of *deductive* inference through which scientific knowledge is configured as an inference capable of making a *computational synthesis of critical integration of reality* which, by constructing virtually and eidetically objective data, makes it possible, in fact, to achieve some *objective knowledge* of the physical world that we can and must subsequently critically test (precisely through verifications and/or falsifications) performed through an accurate and rigorous experimental critical mediation of the different theoretical predictions. This exactly constitutes the decisive innovation of the Kantian transcendentalist stance, which theorised the decisive role of the 'Copernican revolution' precisely to underline how any 'object' of knowledge is such only and solely within a very precise theoretical perspective, within a specific and rigorous conceptual and linguistic universe. The fundamental Kantian swerve, to which Husserl himself refers in a theoretically privileged way—beyond and also *against* his own brief and often reticent explicit acknowledgments—is on a clear collision course with the traditional empiricist image of science that from Hume onwards (but also, and above all, from Francis Bacon onwards) has instead ended up by constituting a sort of widespread common sense for the epistemologists of the last few centuries. Husserl follows exactly the hermeneutic path inaugurated by Kant, by pointing out how, without doubt, animals' actions (which certainly humans share with mammals as a class to which the human species belongs) are largely based on representations and judgments derived inductively and directly from experience (it would suffice to mention—to give just one emblematic example—Aristotelian physics, which constitutes an intelligent rationalisation of the world of common experience). But alongside these fundamental and indispensable actions that put us on a par with animals, there is also an intelligent understanding of the world that requires, instead, a counterfactual reflection, in order to produce

original computational syntheses of the critical integration of the experience itself, as human beings have begun to do systematically, from the birth of modern science onwards. In this case we then focus on identifying some certain 'ideal objects ideationally apprehended in the correlates of our acts' precisely because

> Each truth stands as an ideal unit over against an endless, unbounded possibility of correct statements which have its form and its matter in common. Each actual judgement, which belongs to this ideal manifold, will fulfil, either in its mere form or in its matter, the ideal conditions for its own possible inward evidence. The laws of pure logic are truths rooted in the concept of truth, and in concepts essentially related to this concept. They state, in relation to possible acts of judgement, and on the basis of their mere form, the ideal conditions of the possibility or impossibility of their inner evidence. Of these two sorts of conditions of the inwardly evident, the former relates to the special constitution of the sorts of psychical being which the psychology of the period recognizes, psychological induction being limited by experience. The other conditions, however, have the character of ideal laws, and hold generally for every possible consciousness.

There is therefore an evident discrepancy between the psychological-empirical conception of the world and its objective-ideal conception, which in turn refers to the gap existing between the descriptive psychology as defined by empiricist systems and the epistemology of the critical-rationalist system outlined by Husserl:

> The distinction between the psychological mode of treatment, whose terms function as class-terms for mental states, and the objective or ideal mode of treatment where the same terms stand for ideal genera and species, is not a subsidiary, or a merely subjective distinction. It determines the difference between essentially distinct sciences. Pure logic and arithmetic, as sciences dealing with the ideal singulars belonging to certain genera (or of what is founded a priori in the ideal essence of these genera) are separated from psychology, which deals with the individual singulars belonging to certain empirical classes.

Why? Precisely because scientific analyses (and, consequently, also epistemological ones as critical meta-reflections concerning individual disciplines) constitute 'analyses of meaning, and not in any degree psychological ones. Not individual phenomena, but forms of intentional unities are subjected to analysis, not experiences of syllogising, but syllogisms.'

In this way the transcendentalist analysis, inaugurated by Kant and subsequently freely further developed by Husserl from his phenomenological perspective, is placed on a different level of epistemological investigation, which is critically and in a completely original way detached from the traditional plane of the empiricist tradition. Indeed, for Husserl,

> The question is not how experience, whether naive or scientific, arises, but what must be its content if it is to have objective validity: we must ask on what ideal elements and laws such *objective validity of knowledge of the real* is founded - more generally, on what any knowledge is founded - and how the performance involved in knowledge should be properly understood. We are, in other words, *not* interested in the origins and changes of our world-presentation, but in the objective right which the world-presentation of science claims as against any other world-presentation, which leads it to call *its* world the objectively true one. Psychology looks for perspicuous explanations of the formation of world-presentations. World-science (the sum total of the different sciences of the real) wishes to know perspicuously what obtains *in reality*, what makes up the true, the actual world. Epistemology, however, wishes to grasp perspicuously, from an objectively ideal standpoint, in what the possibility of perspicuous knowledge of the real consists, the possibility of science and of knowledge in general.

Which then leads Husserl to emphasise the role and function of *objective ideality* through which scientific knowledge is established, since the latter, as it should now be evident, does not arise, *passively*, from experience, but is developed, instead, starting from an *objective ideality* through which it is possible to delineate, counterfactually, a theory by virtue of which one is then able to formulate a deductive computational synthesis that allows us to critically integrate experience itself. As Husserl again points out,

> Before all economising of thought, we must already know our ideal, we must know what science *ideally* aims at, what law-governed connections, what basic laws and derived laws etc., *ideally* are and do, before we can discuss and assess the thought-economical function of knowing them.

Which then helps to better understand the obvious conflict that cannot fail to arise between the intrinsic 'necessity' of scientific knowledge (connected to the very concept of 'scientific law' and the predictability of scientific theories which, precisely, presuppose when something *must necessarily* happen) and the construction of empirical representations and of accidental convictions themselves, which appear to be instead devoid of connections with a binding force, even though they possess an undeniable average utility.

> The errors of this trend toward thought-economics, are due in the end to the fact, that those who go with it, like all psychologistic thinkers, have an interest in knowledge which stops short at the empirical side of science. They fail in a certain manner to see the wood for the mere trees. They concern themselves with science as a biological phenomenon, and do not see that they are touching upon the epistemological problem of science as ideally unified, objective truth.

As Karl Popper often observed, the theory of special relativity, from its first formulation, had always expected the *curvature* of rays of light as they pass through a strong gravitational field. This prediction, on the basis of which Einstein precisely established—by rigorous merely deductive inference—how a ray of light should necessarily behave in this specific physical situation (by ignoring a common misconception concerning the constantly rectilinear character of the diffusion of light in infinite space) constituted, at the same time, the main challenge and the glory of Einstein's theory. *The challenge*, because by advancing this prediction Einstein actually made, in the words of Imre Lakatos, his theory of relativity stick its 'neck' out to the cleaver of experience, so to speak. As is well known, this prediction was formulated as early as 1905, but was then experimentally verified only in 1919, which accounts for its *glory*. Indeed, only since then, and of course not surprisingly, was Einstein finally proclaimed one of the greatest physicists in the history of mankind. But it is precisely this aspect connected with the necessity of scientific prediction that has always constituted the concern of empiricism which, with the classic—and certainly glorious and brilliant—Humean analysis of the cause-effect link, nevertheless shows that *ideal ideational role* of scientific theories themselves, which are by no means reduced to the assets of empirical experience, because, if anything, as we have seen, they rather arise from the awareness of the heuristic function of counterfactual ideals that enable us to delineate those deductive computational syntheses with which objective scientific knowledge is developed.

8 The general conditions of the possibility of science according to Husserl

But what are the ideal conditions for the possibility of science? Husserl did not ignore this problem, explicitly investigating the 'conditions of the possibility of science in general', in which he produced some considerations that must be kept in mind because they provide the most fruitful key to explain the link between the objective knowledge elaborated by science and the world of axiology. As already elucidated previously, for Husserl 'the essential aim of scientific knowledge can only be achieved through theory, in the strict sense of the nomological sciences.' Husserl therefore felt authorised to replace the question concerning the conditions of possibility of science in general with the question concerning the '*conditions of the possibility of theory in general*'. In this regard we have already seen that, for Husserl,

> A theory as such consists of truths, and its form of connection is a deductive one. To answer our question is therefore also to answer the

> more general question as to the conditions of the possibility of *truth in general*, and again of *deductive unity* in general.[22]

Of course, it does not escape Husserl that by investigating this a further question is raised more directly connected 'with a quite necessary generalisation of the question as to the 'conditions of the possibility of experience". This is a crucial epistemological challenge that was first identified by Kant in the *Critique of Pure Reason*. Which, if it were still required, confirms that deep underlying connection (often unmentioned by Husserl himself) that exists between Husserlian phenomenology and Kantian criticism, to which I referred earlier. However, Husserl continued, the precise meaning of this question must be further clarified with greater rigor and, in this regard, he added the following:

> It might very well be at first understood *in the subjective sense*, in which case it would be better expressed as a question as to the conditions of the possibility of *theoretical knowledge* in general, or, more generally, of inference in general or knowledge in general, and in the case of any *possible* human being. Such conditions are in part *real*, in part *ideal*. We shall ignore the former, the psychological conditions. Naturally the possibility of knowledge in a psychological regard embraces all the causal conditions on which our thinking depends. *Ideal* conditions for the possibility of knowledge may, as said before, be of two sorts. They are either *noetic* conditions which have their grounds, *a priori*, in the Idea of Knowledge as such, without any regard to the empirical peculiarity of human knowledge as psychologically conditioned, or they are purely *logical* conditions, i.e. they are grounded purely in the 'content' of our knowledge.

It is worth mentioning that this second aspect, which concerns both *noetic* structures and *logical* ones, is at the centre of Husserl's reflection. This appears decisive also for our epistemological reflection. For what reason? Just because, thanks to the *doctrine of intentionality*, a concept (i.e., an *idea*) outlines an objective compass coinciding with its own *noematic* content, which, in fact, determines and qualifies it as that specific idea that becomes part of the different noematic connections that structure the very fabric of objective knowledge, to which we are referring within a specific disciplinary field. Exactly at this point Kant's 'Copernican revolution' comes into play with a fundamental role also in Husserl's reflection.

In the first place, because Kantianism conceives philosophy as a critical meta-reflection that is expressed on previous contents of reflection. This constitutes an important and decisive turning point, also because it annuls philosophy's supposed ability to operate on its own (quite mythical) specific

[22]E. Husserl, *Logical Investigations*, op. cit., Vol I, p. 149 (italics in the text); the following citations in the text are taken from pp. 149–150 (italics in the text).

object. By losing the reference to its own specific metaphysical object, philosophical reflection, as a critical meta-reflection, then opens up, with conscious epistemological humility, to every discipline that it can and must engage with, in order to learn precisely the infinite complexity of the world, which reveals itself in the actual knowledge constructed by humans through science.[23] But by turning to these disciplines to learn and clarify the multiple and different disciplinary contents, however, philosophy then brings with it its own particular methodical (indeed, philosophical) habit, with which it exercises its *critical meta-reflection* by investigating the meaning and significance of these various disciplines, by studying their meanings, their categories and universes of discourse, the way to pose problems as well as the way to solve them, models of inference, etc., without however ever recognising and identifying itself, uncritically, with a specific scientific conceptual universe as the object of its study. This makes it possible that philosophy investigates a scientific discipline by fully highlighting, from an *epistemological* perspective, the appropriate specifically *conceptual* dimension (a dimension of thought which, often is instead lost sight of or certainly forgotten or neglected, both by the composite tradition of empiricism as well as by that of positivism, not to then mention all the various and different metaphysical traditions which have often denied to science even the quality of *being able to think*, which they naturally considered as their exclusive prerogative. This happened, just to offer an emblematic example, in relation to Heidegger's ontological metaphysics, clearly influenced by Nazi theories—an influence that is now finally overtly recognised and no longer dismissed with a significant shrug of the shoulders ...). Precisely this meta-reflective critical attitude turns out to be profoundly in tune with the theoretical attitude of Husserlian phenomenology, which always addresses positive knowledge (that of the sciences), by inviting us to suspend just the natural orientation and perform a decisive *epoché* that makes it possible to develop the *analytical* plan of Kant's reflection that we have just mentioned.

In the second place, from the perspective of Kant's 'Copernican revolution', also the way of considering a *concept* changes: now it can be conceived, *à la* Husserl, as a *non-representative and non-ontological ideal unity*, with which the multiple data of empirical intuition can be connected. In this way

[23] In *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy*, Third Book: *Phenomenology and the Foundation of Sciences*, translated by T. E. Klein and W. E. Pohl, M. Nijhoff Publishers, The Hague, Boston, London, 1980, Husserl wrote: 'Treasures of knowledge may lie in the sciences, indeed, they must lie in them, since we cannot doubt that the claim of their statements to validity is a good one, even though within limits still to be defined. But these treasures of knowledge we do not have; we must first obtain them. For knowledge is insight, is truth drawn from Intuition and thereby completely understood. Only through a work of elucidation and making evident, carried out anew on the given sciences, do we bring out the intrinsic values that are hidden in them.' (p. 82).

the concept is transformed into a heuristic criterion for understanding the world, which makes it possible for us to realise a computational deduction by means of which we are able to present a critical integration of experience. This makes viable, as can be immediately comprehended, the elaboration of a much more articulated critical conception of the same experience, since the latter no longer refers to a merely passive function, because, on the contrary, it requires to be always critically fertilised by thoughts, which are capable of reading and understanding it critically, by bringing it back to a unifying function, coinciding with the concept itself. The object-of-knowledge—coinciding with the different disciplinary objects specific to each discipline—therefore refers to a logical-transcendental function of critical integration of experience, by means of which we are able, in fact, to unify, within a determined universe of discourse (purely conceptual), proper and specific to a particular discipline, all the multiple intuitive contents.

Consequently, and in the third place, the object of knowledge is no longer configured either as a prerequisite for research, or as a totally separate object from the knowledge developed within a specific disciplinary sphere. If anything, once again deeply in tune with Kant's 'Copernican revolution' the object of knowledge is configured—to express it *à la* Sartre—as a specific 'object-of-knowing' that can never be considered by arbitrarily isolating it from the actual field of its scientific discipline. For what reason? Because outside of that theoretical context it no longer has any existence. For this reason, when we speak, for example, of a concept such as that coinciding with an 'element', we are always expected to immediately specify the different disciplinary ambit to which we refer, because the meaning of the concept of 'element' changes, even profoundly, according to the discipline we are referring to (an 'element' in physics is very different from an element in medicine, biology, maths, music, geometry, etc.). Why are we faced with this multiplicity of elements? Exactly because the object-of-knowing can no longer be imagined as *external* to the act of knowing itself (for example as an 'internal' or 'external' element), because for Husserl it is configured, instead, as *a content of the act of knowing itself*, i.e., as a *constitutive polarity of the very objectivity of the ideal unity* through which we objectively study a specific area of the world (physical, biological, mathematical, algebraic, medical, etc.).

From this innovative epistemological and hermeneutic perspective, 'reality', 'existence' and 'truth' itself can no longer be conceived as a sort of archetypal form of reality, presupposed in relation to knowledge, because, if anything, each of them is configured instead, as a *specific modality within the very structures of objective knowledge*, which is constituted by always taking *primarily* into account the specific conditions of a scientific discipline concerning the constitution of the object itself in a specific theoretical

and experimental field. But these constitutive conditions of the object-of-knowledge, conceived as an internal moment of the specific structures of the knowledge developed by the discipline taken into consideration, at the same time provide the conditions of our own experience, which is no longer configured as a neutral and passive dimension, precisely because our experience is formed instead within the ideal tension, with which the world is understood according to its objective necessity.

In this way it seems that Husserlian phenomenology, as an insightful development of the 'Copernican revolution' outlined by Kant, is then able to critically re-establish empiricism itself, by freeing it from all its traditional psychological (and sceptical) limits to inaugurate a new and fruitful perspective and epistemological horizon. In fact, if we assume, with Husserl, the traditional doctrine of *intentionality* as a fundamental structure of human knowledge, then the object-of-knowing can only be configured as a *noema*, that is, as an object that turns out to exist *inside* the act of knowing, precisely because it constitutes the *thought content of that act*, or a content *targeted by intentionality*. Moreover, this decisive Husserlian consideration must also be kept in mind:

> Talk about recognising objects, and talk about fulfilling a meaning-intention, therefore express the same fact, merely from different standpoints. The former adopts the standpoint of the object meant, while the latter has the two acts as its foci of interest. Phenomenologically the acts are always present, while the objects are sometimes non-existent. Talk of fulfilment therefore characterises the *phenomenological* essence of the recognitive relation more satisfactorily. It is a primitive phenomenological fact, that acts of signification [*Signifikation*] and acts of intuition [*Intuition*]can enter into this peculiar relation. Where they do so, where some act of meaning-intention fulfils itself in an intuition, we also say: 'The object of intuition is known through its concept' or 'The correct name has been applied to the object appearing before us.[24]

Indeed, in Husserl's phenomenology the *noema* is configured as the critical synthesis of two different moments: the intentional *morphé* (a function of the critical integration of experience) that addresses the world with a specific intention of significance, and the sensory material, the *hyle*, specific to hyletic data, which is precisely targeted by the intentionality of *morphé*, and, however, has the potential ability to saturate (or not) just that specific *project of signification* through which intentionality tries to conceptually

[24]E. Husserl, *Logical Investigations*, op. cit., Vol. II, p. 206, text between square brackets and italics not in the English text. In this regard, see also the Italian translation with German parallel text of the important volume by Husserl, *La teoria del significato.* Introduction, translation, notes and apparatus by Anselmo Caputo, Bompiani, Milan, 2008, with my *Preface* published on pp. 5–21.

understand the world. It is the functions of critical integration of experience which make hyletic data intentional; these, without the presence of *morphé* would be completely 'deaf' and impenetrable. Indeed experience, *by itself*, is always 'deaf' if we are not able to read it as a unity, in the light of some specific theoretical intentionality, as Galileo Galilei, the acknowledged father of modern science, already knew. Galileo observed, in fact, that nature, although the 'observant executrix of God's commands', is nevertheless always 'inexorable and deaf to our entreaties, will not alter or change the course of her effects.'[25] In short, nature for Galileo is 'deaf and inexorable' in relation to human beings, who should then be able, on their own, to critically probe the deafness of matter, in order to understand it *conceptually* with the aim of identifying within it that cogent necessity capable of tracing the multiple 'passions' of a given phenomenon back to a physical law (as argued on the third day of *The Discourses and Mathematical Demonstrations Relating to Two New Sciences*). To achieve this cognitive end, human beings can only count on their own intelligence and critical abilities (always connected with a specific force of will as well as with a certain necessary physiological well-being). After all, the Galilean treatment of naturally accelerated motion opens with the following consideration:

> Et prima, definitionem ei, quo utitur natura, oppresses congruentem investigare atque explicare convenit. Quamvis enim aliquam lationis speciem ex arbitrio confinare, et consequentes eius passiones contemplari, non sit inconveniens [...], tamen, whenquidem quidam accelerationis specie graveum descendentium utitur natura, eroundem speculari passiones decrevimus, si eam, quam allaturi sumus de our motu accelerato definitionem, cum essentia motus naturaliter accelerati congruere contigerit. Quod tandem, post diuturnas mentis agitationes, repperisse confidimus; ea potissimum ducti ratione, quia symtomatis, deinceps a nobis demonstratis, first respond to atque congruere videntur ea, qua naturalia experimenta sensi repraesant (VIII, 197)
>
> And first of all it seems desirable to find and explain a definition best fitting natural phenomena. For anyone may invent an arbitrary type of motion and discuss its properties; [...] but we have decided to consider the phenomena of bodies falling with an acceleration such as actually occurs in nature and to make this definition of accelerated motion exhibit the essential features of observed accelerated motions. And this, at last, after repeated efforts we trust we have succeeded in

[25]The quotes from Galileo are taken from *Letter to the Grand Duchess Christina of Tuscany* (1615) and *Third Letter on the Sunspots* (1613). Italian edition: New reprint of Edizione Nazionale *Le opere di Galileo Galilei*, edited by Antonio Favaro, G. Barbera Editore, Florence 1968 (first edition 1890–1909), 20 volumes in 21 tomes. The first quotation in the text is taken from Volume V, p. 316, the second quotation from Volume V, p. 218 and the third from Volume VIII, p. 197).

> doing. In this belief we are confirmed mainly by the consideration that experimental results are seen to agree with and exactly correspond with those properties which have been, one after another, demonstrated by us.[26]

This significant link of congruence that Galileo identified as existing between his innovative physical theory, *ex suppositione*, of naturally accelerated motion and the actual physical properties of this motion, experimentally controlled in the laboratory,[27] is precisely related to the Husserlian problem concerning the possibility that every science has of *being able* to identify objective links existing between the objects within the scope of its analysis. Indeed, it is precisely on this level that the more or less complete 'saturation' of a particular project of giving meaning to the world takes place. This project is originated by the specific intentionality of a scientific theory, by virtue of which a specific functional *morphé* formulates computational syntheses of hyletic data, thus configuring a discipline-specific knowledge, which, as we have seen, always arises from a specific critical integration of our experience. In this perspective, 'nature' can therefore only be configured as a 'correlate of consciousness: Nature *is* only as being constituted in regular concatenations of consciousness.'[28] Which, in fact, allows Husserl to distinguish, within the intentionality, as mentioned, 'between the *components proper* of intentive mental processes and their *intentional correlates'* since 'corresponding in every case to the multiplicity of Data pertaining to the really inherent noetic content, there is a multiplicity of Data, demonstrable in actual pure intuition, in a correlative '*noematic content*' or, in short, in the '*noema*'. Consequently, for Husserl,

> the 'parenthesis' undergone by perception prevents any judgment about perceived actuality (i.e., any 'judgment' having its basis in unmodified perception, thus taking up into itself its positing). But it does not prevent the judgment about the fact that perception is consciousness *of* an actuality (the positing of which, however, should not be 'effected'; and it does not prevent any description of this perceptually appearing 'actuality' as appearing with the particular ways in which it is here intended to, appearing only 'one-sidedly', in this or that orientation; and so forth.

[26] Galileo Galilei, *Dialogues Concerning Two New Sciences.* Translated from the Italian and Latin into English by Henry Crew and Alfonso de Salvio. With an Introduction by Antonio Favaro, Macmillan, New York, 1914. For further analysis of Galileo's epistemological stance see F. Minazzi, *Galileo 'filosofo geometra'*, Rusconi, Milan 1994.

[27] On this theme of the analysis of Galileo's epistemological stance see F. Minazzi, *Galileo 'filosofo geometra'*, op. cit. passim.

[28] E. Husserl, *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy*, First Book *General Introduction to a Pure Phenomenology*, Translated by F Kersten, Martinus Nijhoff Publishers, The Hague/Boston/Lancaster, 1983; p. 116; p. 213 (italics in the text); p. 214 (italics in the text); pp. 220–221 (italics in the text).

9 The influence of objective scientific knowledge on axiology

Precisely the correlation between the noetic moment and the noematic moment allows us to better investigate not only the overall nature of scientific knowledge, but also the links themselves that can be established, historically, between the 'world' of science and the 'world' of axiology. In truth, many thinkers, from Plato to the present, have variously underlined the fruitful connection that is always established between *life* and *culture*, between *Geist* and *Leben*, between the drives of life and the dimension of rational reflection. In this regard, Preti, a thinker mentored by Banfi,[29] took into account, in particular, the reflection of the German philosopher Georg Simmel, whom he came into contact with above all thanks to the mediation of his mentor Banfi. Therefore, in *Retorica e logica* Preti writes:

> Culture, any culture, is born out of life: but, once it has arisen, it exercises a kind of asceticism with respect to life, keeps it in suspension, 'turns its back on it' and elaborates ideal forms of validity that obey immanent criteria, no longer that of their immediate vitality. This is true for the specific and distinct value of truth, as for any other value. But, at this point, the forms of culture put life itself in crisis: they disconcert it at the very moment that they tend to reorganise it within broader, richer, more comprehensive horizons. So they come back to life as 'more life'.[30]

Preti, as a faithful follower of Banfi, thus stresses the rich fundamentally antinomic tension which always arises between *Geist* and *Leben*: if in fact life, as a set of vital drives, requires, in the first place, indeed, to be *lived*, on the other hand, thought performs a sort of radical *epoché* compared to the world of praxis or *Lebenswelt*, by placing it, in fact, in parentheses in order to apparently unfold in a dimension which, while taking root in lived experience, nevertheless is presumed to be configured independently of the experience itself. In this perspective *to live* a given reality (whatever it is) turns out to be fundamentally different from *reflecting* on this reality. Reflection must inevitably move away from life—and its blind impulses—in order to create its own 'critical lenses' in the light of which it addresses the world as if observing it from a distance. However, the undoubted critical gain that thought cannot fail to acquire in this way, by evading

[29]For an overall picture of Banfi's mentoring of Preti and of all the intertwining connections within the 'School of Milan', see, in particular, the following volumes: *Sul bios theoretikós di Giulio Preti*, edited by F. Minazzi, Mimesis, Milan-Udine 2015, 2 Vols.; *Mario Dal Pra nella 'scuola di Milano'*, edited by F. Minazzi, therein 2018 and *Sulla scuola di Milano*, edited by F. Minazzi, Giunti, Florence, 2019.

[30]G. Preti, *Retorica e logica*, op. cit., p. 448, while the quotation that immediately follows in the text is taken from p. 449.

the drives and constraints of experience as such, involves a price: that of abstraction and detachment from the body, flesh and blood, and from *lived experiences* themselves. Ultimately, philosophical reflection itself, precisely in its aspiration to universal criticism, is fuelled by this antinomy and is thus configured as a universal reflection that intends to prescind from time while being unable to do anything but operate in the midst of time ...

As we have seen, for Husserl theoretical disciplines always constituted the foundation of normative disciplines. With the consequence that it can then be deduced that every axiological 'world' always presupposes, as its basis (often unmentioned and hidden) an essential reference to the 'world' of scientific culture. Of course, between these two different 'worlds' or, if you prefer, levels of reflection, multiple relationships can always be established because the axiological culture can be in profound harmony with the scientific knowledge of its time, or it can instead create a discord—more or less serious, more or less profound—between scientific culture and the axiological world. When such a discord occurs, we may be faced with a historical crisis of civilisation that can lead to a catastrophic outcome, or to a revolutionary solution, through which a complete reshuffling of cards is performed in order to shape a new society and new prospects for growth and dynamic development. In this regard, Preti still observes that,

> Axiological culture, insofar as it is organised in a system of ethical institutions, tends to close itself in its substantial immutability, in its immanence—as we have seen. And by closing itself it becomes not only extra-vital ('more than life'), but anti-vital ('less life'). And this happens when its real presuppositions have changed, that is when an erroneous image of existence is developed—erroneous precisely from the point of view of knowledge.

Naturally, both of these different worlds have their own specific degrees of 'stickiness' and are also characterised by the specific way in which they are structured and organised. The axiological dimension is thus characterised by a basic contrast which, generally, is established between the dimension of the *Moralität* (which basically refers to the moral conscience of the individual) and its more strictly ethical dimension (the *Sittlichkeit*, to use the Hegelian terminology again, in its turn influenced by the Kantian one) which is recognised, indeed, in the ethical customs of a specific historical society. Generally, at least on the axiological level, the growth and spread of a new specific need for morality constitutes the leaven of a historical society, because this new *Moralität* seeks precisely to establish itself as a hegemonic element by opposing in this way the traditional *ethos* now rooted in a custom perceived as completely 'natural' and, as such, 'unchangeable' (while it is itself a historical product). The new morality intends precisely to undermine the old ethics in order to be able to establish itself as new ethics that is the

expression of a different morality: by subverting the traditional customs, the new morality in fact aims to take their place. In this way morality ends up by historically transforming itself into an ethic which, sooner or later, inevitably, in turn, will be challenged by a new and unexpected morality that will oppose it as an ethical form at that point outdated, obsolete and inadequate for a world which, in the meantime, has changed profoundly. This does not at all open the way to any form of absolute relativism (in itself contradictory) because, if anything, by accepting an interesting critical suggestion of Ludovico Geymonat, expressed in *Scienza e realismo* (1977), it can be observed that, in the course of history, this dialectical relationship between morality and ethos constitutes an interesting series of different cognitive assets specific and peculiar to the civil institutions within which human history unfolds. But in this respect, it is better to quote Geymonat directly. He writes and argues as follows:

> in the first chapter we explained, however, that science cannot be reduced to a collection of theories, each one enclosed in itself; that is, we have said that, to understand the whole meaning of these theories, it is not enough to examine them in isolation one from the other, but it is necessary to place them in what we have called the 'scientific-technical cultural heritage' in continuous evolution, which includes, besides individual theories considered in their completeness, a vast field of non-axiomatisable investigations (investigations ranging: from first explorations of a group of phenomena to attempts to frame them in this or that theory, from the most subtle methodological debates to the analysis of the philosophical implications of axioms assumed on the basis of our deductions, etc.). Well, something similar can be repeated, in our opinion, also for legal systems; that is, if we want to understand their full meaning, we cannot limit ourselves to examining them in isolation one from the other, but we must consider them in a wider framework that includes, in addition to the legal systems themselves, a complex of institutions, of unwritten laws, customs, etc.; therefore, the consideration of the time parameter is essential (as understood by the historical disciplines). We can call this the 'cultural heritage of civil institutions' in order to underline the analogy with the 'scientific-technical cultural heritage.' And just as in order to understand the dynamics of science, we should refer to this kind cultural heritage, so to understand the dynamics of legal systems it seems obvious that we will have to refer, not only to the individual systems considered in their entirety, but to that highly articulated and variable framework, to which we have given the name of the 'cultural heritage of civil institutions'.[31]

[31] L. Geymaonat, *Scienza e realismo*, Feltrinelli, Milan 1977^1, 1982^2 (new revised and enlarged edition), pp. 124–125. On the more mature thought of Geymonat, see my

To adequately understand the complex historical dynamics of this specific 'cultural heritage of civil institutions' it will be necessary to resort to its dialectical analysis, which, of course, can also be employed to understand the specific dynamics of the 'scientific-technical cultural heritage'. In any case, the world of science and that of axiology certainly present a different and specific 'stickiness', precisely because the scientific enterprise has as its vital, main and indispensable fulcrum, namely *criticism* (while in the axiological ambit, as mentioned above, criticism constitutes, if anything, a moment which, in general, occurs mainly within the traditional dialectic between morality and ethics).

In this regard, Preti, by reflecting on the notions of 'truth' specific to the scientific world and the axiological world—or by analysing their respective 'souls', since the 'soul', that is the form of a culture, constitutes its notion of 'truth'[32]—offered the following, valuable, definition of scientific truth:

> while humanistic-literary truth is a value linked to universal concrete historically determined events/experiences, scientific truth is a value that refers to a *free ideal human universality in general*. 'Free' in the sense that it does not recognise any authority as such—neither of men, nor of scholars, nor of tradition: since even a single scientist can recognise it and assert it against even the most venerable and accredited opinions. 'Ideal' because it is, in a certain sense, abstract, that is (rather) formal: its criteria are formal criteria, in a certain sense a priori with respect to every possible experience and every possible discourse. It is not to the concrete (social) human being that it addresses itself, but to an ideal universally human audience, defined only and exclusively by operating and judging according to these criteria.

The criticism that science appeals to is, therefore, an essentially immanent and radical criticism, whose 'foundation' is provided solely by its own arguments, because it can never appeal to any other authority (either person, institution, or tradition). If, in fact, science appeals to an *auctoritas* it ends up by irremediably crippling its own critical spirit, which can only be fulfilled as a 'free ideal human universality in general'. Precisely for this reason scientific knowledge can never generate an absolute and non-transcendable truth, because it can always radically question its own cognitive results. On the other hand, by working in this way, science does not fall into any contradictory absolute relativism, precisely because its knowledge is actually such as it is, or rather it constitutes a kind of *objective knowledge*, which is

third and most recent monograph about Geymonat: F. Minazzi, *Geymonat epistemologo*, Mimesis, Milan-Udine 2010.

[32]G. Preti, *Retorica e logica*, op. cit., p. 379, while the quotations that immediately follow in the text are taken, respectively, from pp. 386–387 (italics in the text) and from pp. 449–450 (italics in the text).

developed and established within a particular 'regional ontology' determined by the discipline itself whose scientific cognitive assets are possibly being examined.[33] This allows us to better understand the dynamic role that science and its objective knowledge can always exercise in relation to the world of axiology. As Preti further wrote,

> knowledge, as regulated by the autovalue of truth alone, is less sticky than *ethos*: of course, it also tends to be preserved, but the law of truth, with the accentuated asceticism it requires, neutralises most of the reasons for stickiness. Science is more 'unprejudiced', and therefore, by its own office, more responsive to the changes that occur in reality. Therefore, by operating critically against the old pseudo-theoretical basis that supports an archaic system of ethical institutions (and therefore of values), it forces it to change, thereby forcing the entire system to re-motivate itself, and therefore to reorganise itself: with the result that different ethical institutions will arise, and will often be *very* different from the previous ones. And so scientific ascesis is a tool for readjusting *ethos* to the demands of life: it restores its foundation to the world of values, the very condition of its effectiveness—it keeps open the ways of its own self-transcendence. This, and no other, is the primary function of scientific knowledge, *as knowledge*, within the historical dialectic of civilisation.

This then configures the eminently dynamic, critical and *liberating* function of the objective knowledge elaborated by science, precisely in relation to the world of values. It is significant that the objection of 'immorality' towards science and scientific knowledge itself has often been raised in the course of history. To the extent that the 'sacred' values of a society are threatened or vacillate on the verge of an epochal meltdown, then it is precisely science, which is *indifferent to values*, that has been variously judged (and condemned) as materialistic, atheist, mechanistic, anti-social and as socially dangerous. Moreover, there have been scientists and epistemologists who have belittled these criticisms by affirming that science is instead deeply sensitive to values and even intrinsically religious, precisely because there is also an intrinsic religiosity of scientificity itself .... But, as we have seen, science does not constitute a world of values, but rather it is configured, if anything, as a complex form of the objective spirit that is organized and forged around an immanent value such as that of scientific truth and immanent criticism, or rather of the objective knowledge of the world achieved

[33]For an original examination of the *L'oggettività e i suoi contesti* I refer both to the exhaustive analysis developed in the homonymous volume by Evandro Agazzi (Bompiani, Milan, 2018) and to my previous monographic study on the epistemological problem of objective knowledge: F. Minazzi, *Le saette dei tartari*, Franco Angeli, Milan, 2004. English version: Evandro Agazzi, *Scientific Objectivity and its Contexts*, Springer International Publishing, Cham, 2014.

by scientific thought through some arguments that can always be improved and made increasingly rigorous and critical. In this precise sense, then science knows only the concepts of true and false, while it completely ignores the concepts of good, bad, ugly, beautiful, adversable and desirable, as the seventeenth-century philosopher Spinoza already stated with great clarity. He elucidated, with undoubted in-depth analysis and clarity, precisely the pure theoretical ideal value of scientific knowledge. But then Spinoza himself paradoxically ended up by unduly overloading this right and correct image of objective scientific knowledge, by transforming it into an *amor intellectualis* which contrasts with the very 'soul' of scientific research. But the 'square circle' outlined by Spinoza was then actually realised also in subsequent human history whenever either an axiological value was wrongly attributed to science or this was attacked precisely because of its lack of values. Faced with this paradoxical situation, if we return to Husserl's approach, it appears clear that the founding noema of a world is precisely the cognitive and theoretical one, whose propositions are either true or false. In this perspective, as we have seen, the axiological dimension exists only on the condition that the primary object exists. Consider the history of witchcraft: witches were variously persecuted as long as it was believed that a discipline such as witchcraft actually existed and also to the extent that an effective cognitive significance was attributed to this discipline. But when the impossibility of witchcraft was finally realised, the persecution of witches gradually disappeared, precisely because its founding proposition—the theoretical-cognitive one concerning the existence of witches—had lost any possible objective value. Similarly, when the physiological pathological nature of epilepsy was finally recognised, the traditional and widespread belief in the 'sacred disease' gradually disappeared from the cultural horizon and epileptics were no longer persecuted as forces of evil or revered as diviners, because an attempt had finally been made to treat them as sick people.

From all these considerations then follows the *well-argued* consequence that we can express by sharing an insightful conclusive remark by an epistemologist like Geymonat:

> what the masses spontaneously but firmly oppose to those who, on the basis of these findings, set themselves up as a severe critic of scientific-technical progress, to which they would like to oppose a culture 'free' from any scientific contamination, can be summarised in a few lines: to stop this progress by invoking purely moralistic arguments or by trying to counteract old ideas of the world with an idealistic background, is the fruit of mere fantasy and is therefore doomed to failure. The real main contradiction of our culture is not between scientific-technical progress and the romantic aspiration to a kind of life that belonged to the pre-scientific era (it might be that it can appear worthy of regret only to those who have not realistically examined all of its aspects, including

> the most cruel and repugnant ones). The main contradiction of our culture is the contradiction itself (between labour and capital) inherent in the societies within which our culture (the scientific-technical one as well as the humanistic one) takes root and develops. It follows that the means to which one must resort to eradicate the evils generated, within this society, by scientific-technical progress are very different and far more serious than those often proposed by the romantic denigrators of scientific rationality and, with it, of the whole modern world. [In this perspective it is necessary] to initiate a truly new civilisation, which dialectically moves beyond the current one, starting precisely from its contradictions: contradictions that cannot be simplistically denied or veiled as if they were a figment of our imagination, but, on the contrary, should be investigated in depth, exasperated, taken to their extreme consequences, until an authentic solution emerges, which can only consist in a real, courageous, revolutionary process.[34]

From this perspective of a much called-for radical social change on a global level, we can then conclude our brief reflection by affirming, paradoxically, this time with Spinoza, that the authentic value of a scientific truth that is *wertfrei* is rooted precisely in its *critical liberating force*. This is its undoubted historical value, which we cannot renounce, since it is this that has historically helped us to emerge from barbarism ...

[34]L. Geymonat, *Scienza e realismo*, op. cit., pp. 142–143.

Interfacing logic and judgment

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1 Introduction

Good judgment is an intellectual quality that goes far beyond being well-informed and possessing good reasoning skills in drawing conclusions from available evidence. Beyond these basic competences, arriving at a judgment involves a further exercise of insight in a space of free decisions. This surplus may suggest a tension with logic, a discipline often seen as imposing automatic rules whose conclusions are 'forced' upon us, a telling, if not ominous, terminology. But the reality is surely cooperation. Logic is an indispensable *pre-processing* tool: good judgments should be based on good evidence and good inferences. And the role of logic does not stop there: it is also a *post-processing* tool for critical inspection: judgments with absurd logical consequences, no matter how profound, are in trouble and should be modified or abandoned.

Yet these obvious connections between judgment and logic are not what this brief paper is about. I rather want to stress the importance of judgment calls *in the practice of logic* itself. My examples will be mainly 'small judgments' about what to infer logically from data at our disposal, or how to make sense of what we see or hear. These are things we do all through life. More momentous 'large judgments' arise with accepting or rejecting a complete conceptual framework or scientific theory, reflecting the large fateful decisions we make only now and then in the course of our lives. For what it is worth, I believe that large and small decisions of this sort lie on an intellectual continuum, but I leave it to the reader to judge the reach of the analysis to follow.

2 Logic: structure and agency

Two faces of logic. A brief explanation may be in order of what is meant by 'logic' in what follows. In one sense logic is the study of a world of abstract relations between propositions and formal systems, and many other structures that do not involve actual reasoners. This is the foundational face of the field. But at the same time, logic is used by agents, or at least we can use it to model real and ideal agents, and this is a second face of the field,

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Comptes Rendus de l'Académie Internationale de Philosophie des Sciences 4 (2025).
J. van Benthem, Interfacing logic and judgment, pp. 159–166.

historically entangled with the first. What follows will be in the second, dynamic mode: judgment arises with 'logic in action' as used by agents.

Judgments as acts. The term "judgment" is used routinely by logicians for an *act* of asserting a proposition, or the *product* of such an act. The difference is often blurred (as it is in our daily natural language), though Frege did indeed make a clear distinction between content and assertion. Be this as it may, the dynamics is obvious: logical reasoning involves acts of drawing consequences, selecting and arranging premises, choosing pathways toward conclusions, and much else.[1] What is more, in addition to more narrowly reasoning-related acts, there are other basic ones.

Information-producing acts. Reasoning is an informational process that lives inside a larger realm of questions, tasks, and inquiry. Most sciences, and for that matter: daily life, crucially involve a mixture of inference with *observation* and *communication*. This point was already noted by the Mohist logicians in China in the 5$^{\text{th}}$ century BC. Their elegant compact statement was "*zhi wen shuo qin*": 'knowledge arises from hearing, demonstration, and experience'. In modern terms, information flows because of what we observe, what is communicated to us, plus the inferences that accompany these, Zhang & Liu 2007.[2] This interplay of many informational actions is not just ancient philosophy, but the reality of everyday agency and the actual functioning of science. Moreover, broader information-producing acts interact naturally with inferences in a stricter sense, and in doing so, they still fall within the scope of logic: they obey laws that are investigated in contemporary dynamic logics of information, cf. van Benthem 2011. This broader dynamic perspective on what happens in information-driven agency is the setting in which we will explore the role of judgment in logic.

3 Judgment and inference

What to infer. A particular valid inference from given premises leaves no room for judgment when passing to the conclusion. This step is automatic, and can in fact be automated on machines. But a much wider open space arises when we consider *which inferences* to draw from given premises. This asks for a guiding question or a *purpose*, and judgment is crucial here. Sherlock Holmes makes the essential relevant inferences from the observed facts, and in this, he has better judgment than most of us. An interesting broad cooperative perspective is explored in the dissertation Icard 2014: semantics supplies the "what" of valid inference, proof theory adds the

[1] Some authors say that reasoning in fact proceeds from judgment act to judgment act, but this may not do justice to the variety of logical acts and epistemic attitudes that agents actually engage in.

[2] A Mohist example is this. I see an object in a dark room and an object outside that is white, someone tells me that the objects have the same color. I now infer that the object in the dark room is white.

"how" of wielding this repertoire, but equally important is the "why" of drawing which conclusion, which is always goal-oriented and involves links with decision theory.[3]

Judgment in mathematical proof. Going beyond single inferences, mathematical proofs encode sustained reasoning through *complex structure* at a higher aggregation level of successive inferences arranged in patterns. While checking for correctness of each step is logic in automatic mode, the complex structure brings issues of its own. On a simplistic view, proofs establish one conclusion: their last statement, and we just have to check each link in the chain or proof tree. But in addition to a final conclusion (and of course also intermediate ones), good proofs have a *moral*: a general point of the proof providing reasons and further pathways whose identification and communication is a matter of judgment going far beyond checking for correctness. Of course, judgments of proof morals can be a matter of continuing debate, witness the century of thinking about the essence of Cantor's diagonal argument, Yanovsky 2003.

Choice of a logical system. But even behind fixed single inference patterns, larger judgments loom in our earlier sense. Is the conclusion of a reductio ad absurdum automatically forced upon us? There is an a priori decision here: classical logic will tell us to accept, intuitionistic logic accepts one version and rejects another. Choices *between different logical systems* require judgment (though there is also dogmatic slumbering in the profession), and in these judgments, a wide range of considerations plays a role, from observable facts about human reasoning to methodological virtues of general architecture, just as in choosing between scientific theories. Of course, these are large judgments by theorists, not by day to day users of logic, but even the latter have the ability in principle to reflect on their reasoning practices.

Identifying the relevant pattern. So far, as is common in the philosophy of logic, we considered abstract patterns placed before us. But in practice, agents need to *discern the relevant patterns* first in the concrete information format at their disposal. Here is a telling example from Mercier et al. 2017: "Twenty farmers own at most fifteen cows each. So: At least two farmers own the same number of cows." Is this conclusion correct? And if so, why? One might be inclined to look for some quantificational pattern close to first-order logic, but that would not work and miss the essence. What is arguably at work here is the mathematical *Pigeon Hole Principle*. Putting 20 objects into the 16 boxes of 'owning i cows' with $0 \leq i \leq 15$ must place at least

[3] Icard provides computational models for investigating the decision-theoretic "why" of inference in precise terms.

two objects in the same box.[4] More generally, discerning logical patterns in real reasoning couched in language or other vehicles for information (visual patterns, movements) requires sometimes quite non-trivial judgments going beyond purely formal skills.

Summary. Reasoning is replete with judgment calls in deciding what to infer, in determining what a complex proof means, or in adopting a logical system. In addition, judgment is essential in bringing logic to bear on concrete reasoning scenarios.

4 Judgment and representation dynamics

Representation and information update. A basic aspect of the broader information processes that we highlighted in the above is their need for *representation* of the relevant facts. These representations can be purely linguistic, but they do not have to be. "A waiter in a café takes orders from three people for wine, beer, and water. Another waiter returns carrying three glasses. What will unfold is this. The new waiter asks who has, say, the wine, puts that, asks who has the beer, puts that, and then puts the remaining glass without further ado." The information flow here involves two questions, two answers, and one final inference by the waiter. As the scenario unfolds, information gets updated as directed by the questions.

One can describe this process in terms of sentences in the language of the participants, but more abstract representations also make sense. Initially, there are 6 options for assigning the glasses that we can diagram using combinations WBw, WwB, etc. After the first question has been answered, the diagram simplifies to 2 possibilities: Bw and wB. The second question and answer reduce this to one, just the actual state of affairs, and the third glass can be put based on a simple (probably unconscious) inference. This is just a simple example, and many other types of representation occur across a spectrum from detailed syntactic language forms to abstract diagrams. Based on this example plus a wealth of literature that we cannot survey here, we make a sweeping claim. Much of logical semantics in philosophy or linguistics is about creating models that can serve as representations of relevant information for agents.

Update rules for representations. As we saw, *updates change models* representing relevant information for a task at hand. There are many rules in logic that describe such changes, from elimination of possibilities as above to Bayesian conditioning or other tools in formal epistemology. In particular, incoming information can be taken in different ways, from 'hard', indubitable and irrevocable, to 'soft', keeping some reservations and fallbacks around. Such varieties may need richer representations.

[4] Van Benthem & Icard 2023 explore the complex entanglement of logic and elementary mathematics.

For instance, *plausibility models*, van Benthem 2011, order epistemic possibilities s, t by a binary order "s is at least as plausible as t" from the standpoint of an agent. One can think of the set of possibilities as what is still in play for the agent after all others have been ruled out in the course of inquiry, while the plausibility order records current expectations or beliefs about these various possibilities, usually based on a past history of evidence gathering. Now a hard update with the proposition φ will totally eliminate all current possibilities satisfying $\neg\varphi$, while a soft update might keep all possibilities around, but put the ones satisfying φ on top as most plausible or most relevant in the updated ordering of the options. Clearly, these are just two out of many options for letting new information impact one's current epistemic-doxastic state, and dynamic epistemic and doxastic logics study a wide range of options.

Uptake requires judgment. The variety of possible update rules for information is often seen as an embarrassment for a research area, being a way of "riding off madly in all four directions", Leacock 1911. But we can also see it as a rich repertoire of options available to intelligent agents who must make a judgment on the quality of new information received and then respond accordingly. Well-considered *uptake* is crucial to communication, and it requires judgments of content, of the communicative scenario or interactive game one is in, of the reliability of sources, and much more.

Balance of logic and free judgment. The preceding perspective raises a perhaps somewhat technical question of independent interest. Is a large and growing variety of update rules the best way of describing intelligent agency, or could there be one logical *Mother Rule* for information update which is inescapable, but whose design makes uptake a free choice parameter? Proposals to this effect include the dynamic-epistemic product update rules for knowledge, Baltag, Moss & Solecki 1998, and for beliefs in Baltag & Smets 2006. By locating some logically inescapable grand pattern for update, this design in fact highlights the precise locus where additional judgment is needed in setting the parameter, providing one more instance of logic and judgment supporting each other.

The open space of representations. Update rules and representation structures from formal semantics, once mathematically defined, follow one particular linguistic groove. But we can also step outside of such a model during the process of inquiry, and radically *change the very representation format,* perhaps switching the whole language employed until now. Movements in this open space of representations occur all the time in logical research, and they require larger judgments of the sort we mentioned before: about the best choice of a new conceptual framework.

Summary. Representation is essential to inquiry. Judgment is required in choosing or changing representations and in deciding on the uptake of

new information in a given representation. Logic can describe this process in a way that identifies the choice points in representation formats and their updates where judgment is needed.

Coda: the dynamic boundary of logic and judgment. Here is one last crucial aspect of our topic as we see it here. Decisions as to the division of labor between logical rules and free judgments need not be taken once and for all. In reality, the interface of automated rules vs. free decisions of agents can shift. We may decide to *trade in some judgmental space* for automated rules when this is practical (like in AI support systems), in analogy with how our brains can automate cognitive tasks performed consciously at first.[5]

5 Judgment in formal epistemology

Many points made in the preceding sections about logic and judgment could be made equally well in the broader area of formal epistemology, Arlo-Costa, van Benthem & Hendricks 2017. In this interface area, logic meets with formal philosophy and other fields, and many standard themes involve judgment calls. We confine ourselves to just a few points going beyond those discussed in earlier sections.

Knowledge claims and belief formation. Formal epistemology contains many accounts of what it means to know, or be entitled to making a knowledge claim, from Plato's justified true belief to modern relevant-alternatives or belief-stability theories. In a longer version of this paper, I would argue that belief formation by agents on the basis of the available evidence leaves essential room for judgment, but for here, I just highlight one interesting feature of beliefs that seems of general relevance to me.

The right to be wrong and revising judgments. Our emphasis on logic in preceding sections may have suggested that judgments are needed on the way to truth and knowledge, with a sort of continuous march toward *correctness*. But this is not the whole story. Beliefs can legitimately *change* under the pressure of new evidence, and it has even been said that a major sign of intelligence is not always being right, but a talent for creative *correction*, Popper 1962. Belief changes can be described in belief revision theory, Gaerdenfors 1986, formal learning theory, Kelly 1996, or in the earlier dynamic-epistemic logics, in the small by changing plausibility orders,

[5]Such automated rules in intellectual performance need not come from logic alone. The probabilistic architecture of Bod, Scha & Sima'an 2003 shows how consciously performed linguistic and logical tasks can over time become a matter of pattern recognition in memory.

But in an opposite direction, we can just as well *take back our freedom*, and open up a rule system we had submitted to for conscious judgment calls. These are not just speculations. For a live illustration, look at current discussions of video-assisted refereeing in professional soccer, or if this is too down to earth, think of the role of judgment versus rules and automation in the Law, Ulenaers 2020.

and in the large by changing representation formats. But even beyond specific frameworks, logic can help release the creativity needed in revision by providing refutations of current beliefs or positions, not just through new evidence, but also in argument or debate. The general moral is that judgments need never be final: they can be shown wrong, and just as in the Law, appeal and revision must always be possible.

Judgment and further epistemic talents. To keep this dynamic of revision alive, a broader canvas may be needed than what has been discussed in this paper. Judgment is a talent or a competence, but equally important are its epistemic siblings: a talent for *doubt*, and indeed: for knowing when to *withhold* or *retract judgment*. This is true in epistemology, but the same talents are valuable in the practice and theory of logic.

6 Conclusion

In this very brief and frankly rather apodictic piece, I have claimed that logical skills and a talent for judgment are natural companions. Looking at the practice of logic itself, both by its theorists and its users, agents need judgment all the time in logical tasks, from drawing the right inferences to choosing representations and modes of information update. In all this, logical analysis can even help identify where logic ends and judgment must take over, though the border between free space for judgment and logical rules can also shift dynamically.

In arguing for this tandem, my examples were mainly about small judgments by agents engaged in given tasks, but larger judgments concerning format or logical system also appeared occasionally. I do not believe that there is a quantum jump here, and much of what I said should hold in the large as much as in the small. But that claim needs more evidence than I can present here.

Finally, a disclaimer may be in place. With all the above, I have not claimed that judgment is exclusively tied to logical reasoning. General argumentation and further considerations play a role, as well as the ability to see new perspectives. Indeed, insisting on too much precision with judgment calls can be tedious: recall Aristotle's famous dictum that it is the hallmark of an educated mind to give each subject the amount of precision it warrants, Aristotle 2004—said by, perhaps not accidentally, a creative logician. But I do hope to have suggested that, whatever other virtues it may have, logic provides an interesting lens for spotting and enhancing judgment calls.

References

Aristotle, 2004, *Nicomachean Ethics*, Penguin Books, Harmondsworth.

H. Arlo-Costa, J. van Benthem & V. Hendricks, eds., 2017, *Readings in Formal Epistemology*, Springer, Dordrecht.

A. Baltag, L. Moss & S. Solecki, 1998, 'The Logic of Public Announcements, Common Knowledge and Private Suspicions', *Proceedings TARK 1998*, 43–56, Morgan Kaufmann Publishers, Los Altos.

A. Baltag & S. Smets, 2006, 'Dynamic Belief Revision over Multi-Agent Plausibility Models', in G. Bonanno, W. van der Hoek, M. Wooldridge, eds., *Proceedings LOFT'06*, Department of Computing, University of Liverpool, 11–24.

J. van Benthem, 2011, *Logical Dynamics of Information and Interaction*, Cambridge University Press, Cambridge UK.

J. van Benthem & Th. Icard, 2023, Interleaving Logic and Counting, *Bulletin of Symbolic Logic* 29:4, 503–587.

R. Bod, R. Scha & Kh. Sima'an, eds., 2003, *Data-Oriented Parsing*, CSLI Publications, Stanford University.

P. Gaerdenfors, 1988, *Knowledge in Flux. Modeling the Dynamics of Epistemic States*, The MIT Press, Cambridge MA.

Th. Icard, 2014, *The Algorithmic Mind*, PhD Thesis, Department of Philosophy, Stanford University.

K. Kelly, 1996, *The Logic of Reliable Inquiry*, Oxford University Press, Oxford.

S. Leacock, 1911, *Nonsense Novels*, J. Lane Co., New York.

H. Mercier, G. Politzer & D. Sperber, 2017, What Causes Failure to Apply the Pigeonhole Principle in Simple Reasoning Problems? *Thinking & Reasoning* 23:2, 184–189.

K. Popper, 1962, *Conjectures and Refutations, The Growth of Scientific Knowledge*, Routledge, London.

J. Ulenaers, 2020, The Impact of Artificial Intelligence on the Right to a Fair Trial, *Asian Journal of Law and Economics* 11:2, 2020-0008.

N. Yanofsky, 2003, A Universal Approach to Self-Referential Paradoxes, Incompleteness and Fixed Points, *Bulletin of Symbolic Logic* 9:3, 362–386.

J. Zhang & F. Liu, 2007, 'Some Thoughts on Mohist Logic', in J. van Benthem, S. Ju & F. Veltman, eds., *A Meeting of the Minds, Proceedings LORI Beijing 2007*, College Publications, London, 85–102.

The relevance of judgment for the philosophy of science: reflections from the perspective of Kant's Third Critique

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The British philosopher of science Elie Zahar claimed in his essay "Conventionalism and Positivism", "that Kant was, among other things, one of the greatest philosophers of science of all time." (Zaher, 1980) Kantians were *mutatis mutandis*, according to Zahar, William Whewell, Ernst Mach, Pierre Duhem, Henri Poincaré, Émile Meyerson and Karl Popper. The relativity physicists and philosophers Hans Reichenbach, Adolf Grünbaum and Werner Heisenberg analyzed Kant's space-time concept in detail in their works and modified it with improvements.

Kant's significance for the philosophy of science has been discussed in the last century primarily with regard to Newtonian physics or classical mechanics, especially among German Neo-Kantians, who claimed that Kant had endeavoured intensively to deepen Newtonian principles of mechanics through epistemological principles in order to elaborate a metaphysics as a theory of science. Kant, namely claimed in the preface to the second edition of the *Critique of Pure Reason*, that natural science had found its highway with Newton's discovery of the laws of motions (*axiomata, sive leges motus*).

In this context, Kant praises Francis Bacon as the "first and greatest natural scientist of modern times [...] [who] drew attention to the importance and indispensability of observations and experiments for the discovery of truth" (AA 9:32).

In his pre-critical phase, Kant had already chosen Newton's scientific method as the best and most reliable method of argumentation in his treatise "Enquiry Concerning the Clarity of the Principles of Natural Theology and Ethics." (1763). Human reason, Kant claims, has discovered the laws by means of which natural phenomena can be plausibly interpreted and explained: "The true method of metaphysics is basically the same as that introduced by Newton into natural science and which has been of such benefit to it." (Kant AA2; 1912 [1763], 286) In this treatise, Kant claimed that the unboundedness of hypotheses can be brought into a safe procedure with the help of experience and the geometric method. Although Newton's physics had a decisive influence on Kant's pre-critical development, Newton's influence on Kant increased in the critical epoch. Stephen Toulmin has, e.g., characterised Kant's *Critique of Pure Reason* as a hermeneutic of Newtonian

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physics as set out in his work *Philosophiae Naturalis Principia Mathematica*, 1687 (Toulmin, 2002).

Kant's new transcendental method proved to be a more radical implementation of Newton's scientific method in the field of metaphysics; the new, critical metaphysics was to be modelled on Newton's physics. Due to Kant, Newton's method has become the model of safe and reliable reasoning in philosophy. For Kant's epistemology, the rule applies that the *mundus sensibilis* is governed by the principles of pure understanding (Verstand) and, building on this, by Newtonian physics. Following Newton, Kant recognized that scientific knowledge about our world is possible because natural phenomena are ordered by concepts and principles of the human mind. It is the discovered laws of nature whose necessity is based on principles that Kant called "a priori." Kant tried to establish philosophically what Newton proved empirically.

With regard to the influence of Kant's philosophy of science, the American philosopher of science Philip Kitcher claims that all attempts at a unifying explanation of the world according to the model of covering-law use the language of Newton's scientific methodology and Kant's systematic scientific argumentation. According to Kitcher, Kant elaborated this in the *Critique of Pure Reason*, more precisely in the appendix to the transcendental dialectic. It is, in fact, philosophy of science understood as a form of unification: "The idea that explanation is connected with unification has had some important advocates in the history of philosophy of science. It appears to underlie Kant's claim about scientific method and its surfaces in classic works in the logical empiricist tradition" (Kitcher, 1989).

According to Kitcher, Kant's idea of the systematic unification of science from the appendix of *Critique of Pure Reason* (CPR A646-47/B674-75) sounds like a representative of the hypothetico-deductivist orthodoxy of 20th-century philosophy of science: we support our versions of theory by testing their observational consequences. These are, as W. C. Salmon has pointed out, in fact, "Nomic patterns" in the philosophy of science, which is to be seen as the legacy of Newton's and Kant's search for the unity of science: "the explanation of events consists of fitting them into the patterns that exist in the objective world" (Salmon 1989, 121).

Referring to Kant, Michael Friedman claims, e.g., that a multitude of phenomena should be explained by reducing them to law-like sentences or by a unified worldview. By unifying our knowledge, we reduce the multitude of phenomena or regularities to a few laws. (Friedman, 1974, 5–19.)

In the Analytic of Principles (Analytik der Grundsätze) of the *Critique of Pure Reason*, Kant addresses the power of judgement as a third faculty of knowledge, namely as the ability to subsume under rules (concepts of understanding) or "to distinguish whether something is under a given rule

(casus datae legis) or not" (CPR B 171). The power of judgement is also assigned the applicative dimension, because it is supposed to determine whether categories as pure concepts of understanding are applicable to phenomena or not (cf. CPR B 170). Accordingly, in Kant the complex relationship between the particular and the general is fathomed by the power of judgement.

On the one hand, the "Principles of Pure Understanding" set out in the *Metaphysical Foundations of Natural Science* (1786) form the basis for Kant's metaphysics of nature as the final part of transcendental analysis. Principles of pure reason also function as structural principles of scientific research. They prove to be the principle of judgement for scientific research, and scientific practice is guided by them.

Kant paradoxically concludes his Elementary Doctrine in the *Critique of Pure Reason* in an appendix to the transcendental dialectic, thereby completing his critical work of reason in the theoretical realm (CPR B 698). The knowledge of experience is extended here through the use of ideas with regard to "systematic unity" (CPR, B 699). The unity of reason should be spread "over all possible cognitions of experience" (CPR, B 707).

Kant claims that "all human knowledge begins with perceptions", "goes from there to concepts [categories as pure concepts of understanding] and ends with ideas" (CPR, B 730). This important quotation from the first Critique is proof of how Kant's epistemology remains connected to his philosophy of science. Kant explores the question of how philosophy as metaphysics is possible as a natural science. In other words, Kant characterizes the ability of reason to form a system from the diversity of knowledge as the criterion of scientificity. In the chapter "Architectonics of Reason", Kant says: "Because systematic unity is that which makes common knowledge a science in the first place, i.e. makes a system out of a mere aggregate of it, architectonics is the doctrine of the scientific in our knowledge in general, and it therefore necessarily belongs to the doctrine of method." ("die Lehre des Szientifischen in unserer Erkenntnis überhaupt") (CPR, A 832/B 860).

If one considers Kant's philosophy of science solely as an attempt to unify experience from the standpoint of the *Critique of Pure Reason* and the *Metaphysical Foundations of Natural Science*—as is the case in interpretations by Neo-Kantian thinkers, or such as Kitcher and Friedman—then I would argue that this approach needs to be supplemented. Kant's philosophy of knowledge and science should also be examined from the perspective of his *Critique of Judgment*. In this work (1790), Kant acknowledges that life in nature cannot be fully explained by the categories as pure concepts of understanding. Therefore, he seeks to explore the purposiveness of nature through reflective judgment.

Kant's enormous philosophical merit lies in the fact that, in the *Critique of Judgment*, he made the power of judgment a philosophical theme for the first time by treating it as an independent cognitive faculty.

In this article, I aim to show why Kant's analysis of reflective judgment is potentially relevant to the philosophy of science. In the *Critique of Judgment* (1790), instead of the "totality of experience"—a central theme in the *Critique of Pure Reason*—Kant introduces the already given unity of natural formations (*Naturgebilde*), which serve as the starting point for reflective judgment. This shift in the third critique—from the idea of the unity of reason to the reflexive power of judgment—was made because more could be achieved through the teleology of nature than through its mechanistic explanation. In the *Critique of Judgment*, Kant analyzes concrete cases with sensitivity and attentiveness, considering them within their holistic context through the lens of reflective judgment. In order to adequately subsume concrete cases, reflective judgment must first discover the appropriate rules, which are then tested for their applicability. Through Kant's explication of reflective judgment, the heuristic method—particularly important in scientific theory—comes to the fore.

Kant's metaphor of the judge, which was a favourite topic of his philosophy, is very important for understanding reflexive judgment (Kant 1787, CPR, BXIII; AA3, 10). It is a vivid example of how the human capacity for criticism and judgment can be integrated into the scientific understanding and explanation of phenomena in the context of the laws of nature. This ability to judge should be practiced and constantly improved, both as an applicative activity of the existing laws to concrete cases and as a reflective power of judgment in which the appropriate law is investigated.

Jaakko Hintikka believes that Kant's exploration of nature according to the kind of dialog that an expert judge has with nature could be taken as a good model of the methodology of natural sciences, after the disaster caused by Kuhn's "paradigm shift" because it "amounts to modelling all research as a questioning process." (Hintikka, 2007, 71). Hintikka saw Kant's exploration of nature in the manner of an experienced and competent judge as a continuation of Socrates' elenchus—the critical search for truth and the rejection of unacceptable hypotheses and assumptions.

In his *Critique of Judgment*, Kant recognized that the scientific-philosophical dialogue with nature is far more complex than what a purely mechanistic explanation can offer. Life, in its richness and complex purposiveness (*Zweckmäßigkeit*), cannot be explained by mechanistic laws and principles alone; as Kant famously stated, there will never be a "Newton of the blade of grass" (AA V, §75, 400). Organic life in nature can only be understood through a "causality according to purposes", and never solely through the mechanisms of nature. Consequently, the fundamental question

posed in the *Critique of Pure Reason*—the conditions of the possibility of experience—must also be further developed from the perspective of reflective judgment. The organic world with its inner purposefulness cannot be made plausible on the basis of mechanical laws, but is investigated by the reflective power of judgment. Biological purposefulness remains the pivot of reflective judgement, which, on the one hand, implies the scientific practice of research into the final cause, and, on the other, brings the understanding of the world of life, the crown of which remains man with his moral dignity.

In the *Critique of Judgment*, Kant analyses concrete cases sensitively and attentively in their holistic context with the help of reflective judgment. In order to adequately subsume concrete cases, the reflective judgment must first find the rules or laws that are tested for their applicability. Through Kant's explication of reflective judgment, the heuristic method, which is particularly important for scientific theory, comes to the fore. However, if we take Kant's reflections from the *Critique of Judgment* into account, new possibilities for scientific interpretation begin to emerge. When the reflective power of judgment seeks a nomothetic explanation of natural phenomena, the resulting solutions take on a normative character. This is a heuristic process of research and investigation—one that is continually revised and improved. Kant's concept of teleology from the *Critique of Judgment* has experienced a remarkable renaissance in contemporary philosophy of biology (see A. Breitenbach, M. Massimi). This form of inquiry suggests that the investigation of nature should be conducted according to the model of an "appointed judge" (*Critique of Pure Reason*, B XIII)—that is, through the power of judgment cultivated in dialogue with experts.

A competent assessment of nature as a demanding *interpretandum* requires both subject-matter knowledge and the assessor's ability to analyze it thoroughly. In the *Critique of Judgment*, Kant opened a new chapter in the discourse of scientific theory by asserting that the living processes of nature and our life-world cannot be adequately explained in purely mechanistic, causal terms.

Already in the theory of schematism in the *Critique of Pure Reason*, the power of judgment is analyzed as a link between two branches of knowledge: cognition and perception. It should be noted that the interpretation of schematism must be supplemented by the elaboration of the power of judgment in Kant's *Critique of Judgment*, where it now functions as a link between theoretical and practical domains. The real issue with the transcendental doctrine of judgment in the *Critique of Pure Reason* is that judgment is only thematized as the determining power of judgment—that is, the ability to subsume under a rule. The reflective power of judgment, which seeks the general in what is not already known, is only analyzed in the *Critique of*

Judgment. This is why the heuristic dimension of science (*Wissenschaft*) is not addressed in the *Critique of Pure Reason*.

Kant's enormous philosophical merit lies, among other things, in his emphasis on the philosophical significance of the power of judgment—an aspect that has unfortunately been largely sidelined in the discourse of the philosophy of science. The most important role Kant attributes to the power of judgment is its function as a bridge between the theoretical approach and practical application. With the motto "critique instead of theory" (*Kant, AA, V, 170*), Kant anticipated the later critique of theory-ladenness in the philosophy of science.

Kant sought to highlight the immense significance of the heuristic dimension of judgment, which investigates and explores the realm of our lived world. As living beings who hermeneutically interpret ourselves within our lifeworld—particularly in the context of scientific and technological progress—we are also guided by the questions addressed by the reflective power of judgment, which evaluates our lifeworld according to the "causality of ends." According to Kant, the human being is an "organized being" who possesses the "power to form within himself" and bears responsibility for the world in which he lives (Kant, AA V, 374). Kant maintains that the power of judgment presupposes a system of nature governed by empirical laws. It is important to characterize the structure of nature, as Kant describes it, by its divisions into genera and species—"which makes it possible for our power of judgment to find consensus in the comparison of natural forms and to arrive at empirical concepts" (Kant, AA XX, 230).

The organic world, with its inherent purposiveness, cannot be fully explained by mechanical laws alone; rather, it is investigated by the reflective power of judgment. Biological purposiveness remains the central focus of reflective judgment, which, on the one hand, underpins the scientific practice of inquiry into final causes, and, on the other, contributes to our understanding of the world of life—at the pinnacle of which stands the human being, endowed with moral dignity.

With reflective judgment, new dimensions can be uncovered within the field of the philosophy of science. All research and problem-solving within a scientific paradigm or an established scientific theory occur according to the model of the power of judgment—whether determining or reflective. The unification of heuristic maxims takes place and becomes evident in scientific research practice. Reflective judgment can be understood not only as a heuristic principle but also as a means of critically examining existing forms of scientific theory. Scientific breakthroughs and the discovery of novelty are often enabled by reflective judgment, which in turn leads to the reshaping of existing theories or shifts in scientific paradigms.

The teleological power of judgment opens up a scientific-theoretical discussion on the necessity and nature of supplementing mechanistic scientific explanations with teleological heuristics. Through the reflective teleological power of judgment, Kant provides a key to a theory of the organism.

Wolfgang Bartuschat, in his article "On the Power of Judgment" written for Willaschek's *Kant-Lexikon*, argues that Kant's teleological theory of nature has left scarcely any trace in biological theory. Instead, efforts have been made to render it fruitful for critical discussions about the status of hypotheses in the natural sciences, specifically through its association with a merely reflective power of judgment.

With regard to the application of Kant's concept of judgment to hypothesis testing, Pierre Duhem asserts that in choosing a scientific hypothesis, it is not the spirit of logic and geometrical precision that plays the decisive role, but rather the spirit of refinement (*l'esprit de finesse*) and elegance—that is, prudent judgment (*bon sens*): "in order to estimate correctly the agreement of a physical theory with the facts, it is not enough to be a good mathematician and skillful experimenter; one must also be an impartial and faithful judge" (Duhem, 1906/1991, 218).

Kant explicitly emphasizes in his 1793 essay *On the Saying: "That May Be Correct in Theory, But Is of No Use in Practice"* that the applicability of theoretical knowledge in practice depends precisely on the ability to judge concrete situations. This is because, as he notes, "there are no rules by which the capacity of judgment (Urteilskraft) can be governed" (I. Kant, AA 8, p. 275).

Kant argues that the gap between theory and practice can be bridged through the use of reflective judgment. Reflective judgment enables us to determine whether a concrete case can be subsumed under a given rule or law. This form of judgment is particularly relevant to the work of doctors, judges, and politicians, who must strive to resolve concrete cases and situations in the most appropriate way.

Kant's reflective power of judgment explores natural phenomena in terms of their functionality and purposiveness (*Zweckmäßigkeit*). It is, in essence, a heuristic mode of inquiry—an *ars inveniendi*—whose aim is to facilitate the discovery of previously unknown truths. Without the activity of reflective judgment, the scientific process would remain a mere mechanical act of subsumption (cf. Kant, AA V, 411; cf. AA XX, 208 ff).

This implies that natural phenomena should not only be examined from a mechanistic perspective but also from the standpoint of teleological observation. In the *Critique of Judgment*, Kant recognized that the richness and vitality of nature cannot be fully grasped through the use of categories (*reine Verstandesbegriffe*) alone. For this reason, he assigns this complex interpretive task to reflective judgment in his third critique.

Reflective judgment represents a subtle form of inquiry in which the general is not merely inferred in a mechanical manner, but instead involves careful and thorough consideration of whether—and to what extent—a superordinate generalization adequately accounts for the empirical diversity of the given. In this process, reflective judgment critically examines and explores existing forms of connection. Advancements in scientifically recognized knowledge can be achieved through the innovative inquiry of reflective judgment, whose genuine aim is to expand understanding. As an effort to clarify particular cases, reflective judgment has often led to new discoveries.

In this context, it is important to bear in mind, as Kant emphasized, that "there are no rules by which the power of judgment can be regulated" (I. Kant, AA 8, p. 275). It is a hallmark of our autonomy that we are always able to consider the judgments of competent individuals and consult their expertise as authoritative.

The discoveries of Nobel Prize winners John Robin Warren and Barry James Marshall serve as a clear example of how the power of judgment operates. Warren and Marshall demonstrated that the bacterium *Helicobacter pylori* is not a consequence of gastritis and duodenal ulcers, but rather their actual causative agent. The revolutionary aspect of this discovery was that the treatment of gastric and duodenal ulcers shifted from invasive surgical procedures to antibiotic therapy.

This groundbreaking medical discovery came about when Marshall ingested a large quantity of the bacterium, which he had previously cultured in the laboratory, and subsequently developed severe gastritis. By taking antibiotics regularly, Marshall successfully cured his self-induced condition.

One of the accidental discoveries of epochal importance for the development of technology through applied science was Hans Christian Oersted's experiment in 1820, when he observed that a magnetic needle rotates when a current-carrying conductor is placed next to it. Building on Oersted's discovery, Michael Faraday was the first scientist to demonstrate the principles of converting electrical energy into mechanical energy. Similarly, in 1831, Faraday was the first to prove that the movement of a conductor in a magnetic field can generate electricity. These two discoveries formed the foundation for the development of electric generators and motors.

The cognitive achievements that lead to the discovery of new issues in the sciences are, in most cases, the result of reflective judgment—not bound by established theories and rules, but rather marked by a form of ingenious insight that significantly deviates from conventional scientific methodology. From this perspective, it is plausible to suggest that such judgment involves expanding or modifying our knowledge within the domain of empirical cognition, all within the framework of existing theories. In this regard, what Kant described as a heuristic research project remains essential: "to

investigate the particular laws of nature" (AA V, 411; cf. AA XX, 208ff.). In this context, Heiner Klemme aptly refers to the *Critique of Teleological Judgment* as a "heuristic of natural science." (Klemme, 2009).

Scientific research is primarily concerned with the application of what T. S. Kuhn called "normal science." The outcome and success of such research depend on our ability to exercise the power of judgment. The judgment of experts remains an integral part of scientific reasoning—that is, Kuhnian "normal science." The acceptance of a paradigm presupposes judgment as a condition for its successful application. When anomalies arise within a scientific paradigm, they call for reflective judgment—an evaluation that seeks better options for new theoretical explanations. Whether this leads to a scientific revolution, a paradigm shift, or merely a transformation of the existing paradigm ultimately depends on the judgment of the scientific community. None of this is possible without reflective judgment—what Kant referred to as *reflektierende Urteilskraft*.

As living beings who hermeneutically interpret ourselves within our lifeworld—especially in the context of scientific and technological progress—we are also guided by the kinds of questions that the reflective power of judgment analyzes, in order to evaluate our lifeworld according to the "causality of purposes". According to Kant, the human being is an "organized being" who possesses the "power to form within himself" and bears responsibility for the world in which he lives (AA V, 374). In his *Critique of Judgment*, Kant convincingly argues that judgment is central not only to human rationality but also to scientific research and inquiry. It serves the purpose of improving our lifeworld by helping us understand the integrated functioning of our natural and intellectual capacities in the production of human experience, knowledge, understanding, and action as a whole. Science, scientific research, and investigation must never be directed against human dignity.

The primary tasks of philosophy in modern society should be to cultivate our mind and strengthen our ability of judgment. Successful cultivation of our judgment implies professional competence and the ability of reflexive analysis of everything that represents the creativity of the human spirit, cultural and intellectual heritage as well as the scientific achievements. In my opinion, philosophy of science should be conceived as critique in a Kantian sense, based on the foundation of judgment. It should analyze the *interpretandum* and test existing scientific theories and current paradigms under the truth content (*sub ratione veritatis*). In other words, it means that philosophy of science cannot be satisfied with a merely descriptive understanding of what exists, or with the reconstruction of thought of some philosopher, but rather must analyse the *interpretandum under the aspect of truth value, just as philosophy according to its inner determination requires that it tend toward progress, through correction of existing irregularities.*

The President of the German Research Foundation (DFG), Peter Strohschneider, in his speech at the ceremonial event held during the 2018 DFG Annual Meeting, acknowledged the importance of scientific judgment (*wissenschaftliche Urteilskraft*):

> Wir sind auf wissenschaftliche Urteilskraft nicht nur angewiesen, um irgendwie zu vertretbaren Entscheidungen bei der Verteilung von Projektmitteln zu kommen. Das freilich auch. Weit darüber hinaus kommt es indes auf diese vernünftige Urteilskraft an, weil wir ohne sie das Wissenswerte keineswegs unterscheiden könnten vom unabgrenzbaren Gemenge dessen, was man überhaupt zu wissen meinen kann. Wir wären ohne Urteilskraft ganz außerstande, darüber Rechenschaft abzulegen, was wir womöglich wissenschaftlich und technologisch tun können und was wir keinesfalls tun dürften oder tun sollten. [...] Moderne Wissenschaft hätte ohne sie gar keine Zukunft. Denn Urteilskraft ist jenes Band, dass die Wissenschaften in Beziehung hält mit einem aufgeklärten Wissen von den Umständen des menschlichen In-der-Welt-Seins und einer freien Gesellschaft. (Strohschneider, 2018, pp. 8sq).[1]

The fact that Kant aimed to systematize the elements of knowledge—arising from the activity of the power of judgment—into a coherent, organic whole of science with particular relevance is also attested to in his *Opus Postumum*. The idea of a unifying science remains at the forefront of Kant's final intellectual endeavors "Das Fortschreiten in einer Erkenntnis als Wissenschaft überhaupt (...) fängt davon an die *Elemente* derselben aufzufinden und dann die *Art, wie sie zusammengeordnet werden sollen (systematisch) zu verknüpfen* da dann die Eintheilung dieses Geschäftes in Elementarlehre und Methodenlehre die oberste Einteilung ausmacht, wovon jene die Begriffe, diese die Anordnung derselben, um ein Ganzes der Wissenschaft zu begründen vorstellig macht" (AA XXI, 386).

References

Duhem, Pierre (1906/1991): *The Aim and Structure of Physical Theory*, Princeton: University Press.

[1]We rely on scientific judgment not only to arrive at reasonably justifiable decisions regarding the allocation of project funding—though that, of course, as well. But far beyond that, this rational judgment [*vernünftige Urteilskraft*] is essential, because without it, we could not possibly distinguish what is worth knowing from the indistinct mass of what one might merely *think* they know. Without judgment, we would be entirely incapable of accounting for what we may possibly be able to do scientifically and technologically—and what we, under no circumstances, should or ought to do [...] Modern science would have no future at all without it. For judgment is the very bond that connects the sciences with an enlightened understanding of the conditions of human existence in the world and with a free society.

Hintikka, Jaakko (2007): *Socratic Epistemology: Explorations of Knowledge-Seeking by Questioning*, Cambridge University Press.

Kant, Immanuel (1900–2020): *Gesammelte Schriften (Akademie-Ausgabe)*, Berlin-Brandenburgische Akademie der Wissenschaften.

Kant, Immanuel (2009): *Kritik der Urteilskraft. Beilage: Erste Einleitung in die 'Kritik der Urteilskraft'.* Mit einer Einleitung und Bibliographie herausgegeben von Heiner F. Klemme, Hamburg: Meiner.

Kitcher, Philip (1989): "Explanatory Unification and the Causal Structure of the World", in: Philip Kitcher, Wesley C. Salmon (eds.), *Scientific Explanation.* Minnesota Studies in the Philosophy of Science, Volume 13. Minneapolis: University of Minnesota Press, pp. 410–505.

Salmon, Wesley (1989): "Four Decades of Scientific Explanation." In: Philip Kitcher, Wesley C. Salmon (eds.), *Scientific Explanation.* Minnesota Studies in the Philosophy of Science, Volume 13. Minneapolis: University of Minnesota Press, pp. 3–219.

Strohschneider, Peter (2018): "Urteilskraft." Rede anlässlich der Festveranstaltung im Rahmen der Jahresversammlung der DFG am 3. Juli 2018 in Bonn. DFG: Bonn.

Toulmin, Stephen (2002): "Hermeneutics of the Natural Sciences", In: Babette E. Babich (ed.) *Hermeneutic Philosophy of Science, Van Gogh's Eyes, and God*, New York: Springer, pp. 25–32.

Zahar, Elie (1980): "Positivismus und Konventionalismus", in: *Zeitschrift für allgemeine Wissenschaftstheorie/Journal for General Philosophy of Science* 2 (Vol.11), 292–301.

Zovko, Jure (2021): *Hermeneutische Relevanz der Urteilskraft/Relevance of Hermeneutical Judgment.* Philosophy in International Context, Volume 12, Münster: Lit Verlag.