



# Future Contingency and Classical Indeterminism

Richard Gaskin<sup>1</sup>

Received: 8 June 2021 / Accepted: 3 December 2021 / Published online: 30 December 2021  
© The Author(s) 2021

## Abstract

A position that has been called ‘classical indeterminism’ has recently been developed in order to model vagueness: this approach appeals to an object-language ‘determinately’ operator, the semantics of which are defined in such a way as to preserve the principle of bivalence. I suggest that a prominent argument against this strategy, which I call the Field–Williamson argument, fails. The classical indeterminist position in its general form was anticipated by the Aristotelian commentators in their discussions of Aristotle’s famous ‘sea battle’ passage concerning future contingency. But I maintain that, ironically enough, the strategy is less happily applied in this case, where a version of the Field–Williamson argument succeeds.

## 1 Vagueness and ‘Classical Indeterminism’

An approach to the phenomenon of vagueness in natural language that Hartry Field has called ‘classical indeterminism’ (2008, p. 151) posits a (perhaps tacit) object-language operator, which I symbolize as ‘ $\Delta$ ’, meaning ‘definitely’ or ‘determinately’ (these adverbs here being taken to be synonymous, likewise with ‘indefinitely’ and ‘indeterminately’).<sup>1</sup> This operator conforms to an analogue of the weak modal logic KT: that is, we maintain analogues of the meta-rule of necessitation, namely

$$\text{If } \models A \text{ then } \models \Delta A;$$

of the T-axiom, namely

$$\models \Delta A \rightarrow A;$$

<sup>1</sup> See McGee (1989, esp. p. 535, 1991, esp. pp. 219–220), Field (2001, esp. pp. 225–234, 286–289). See also McGee and McLaughlin (1995, 1998, 2004, pp. 125–129), Eklund (2002), McGee (2005), Barnes (2010), Barnes and Williams (2011), Barnes and Cameron (2011, pp. 2–3, 2017, pp. 124–125).

✉ Richard Gaskin  
richard.gaskin@liverpool.ac.uk

<sup>1</sup> Department of Philosophy, School of the Arts, University of Liverpool, Mulberry Court, Mulberry Street, Liverpool L69 7ZY, UK

and of the K-axiom, namely

$$\models \Delta(A \rightarrow B) \rightarrow (\Delta A \rightarrow \Delta B).^2$$

The operator ‘ $\Delta$ ’ (like ‘ $\square$ ’ in KT) distributes over conjunction but not over negation or disjunction. Borrowing an idea from supervaluationism,<sup>3</sup> a classical indeterminist lays it down that ‘ $\Delta A$ ’ is true (false) just if ‘ $A$ ’ is supertrue (superfalse)—that is, true (false) on all legitimate precisifications. (A legitimate precisification preserves the modal status of otherwise determinately true or determinately false statements.)<sup>4</sup>

Now supervaluationists typically identify truth (falsity) with supertruth (superfalsity), so that, since vague statements<sup>5</sup> are neither supertrue nor superfalse, the principle of bivalence has to be suspended, if such statements are to be accommodated, and restrictions placed on the operation of several classical rules of inference.<sup>6</sup> By contrast, according to the classical indeterminists’ strategy for dealing with vagueness, supertruth is identified with *determinate* truth, not with truth *simpliciter*; in consequence classical logic and classical semantics can both be fully preserved. In particular, classical indeterminists may continue to maintain not only the law of excluded middle (which supervaluationists accept) but also the principle of bivalence (which supervaluationists reject), so that a vague statement is either true or false, and indeed determinately so; but one cannot ‘divide’, as the Aristotelian commentators put it (in connection not with vagueness, but with future contingency, to which I turn in §2), and say that it is either determinately true or determinately false. Thus classical indeterminists maintain, in full generality, both the law of excluded middle, ‘ $\models A \vee \sim A$ ’, and the analogue of its necessitation, ‘ $\models \Delta(A \vee \sim A)$ ’. But they do not subscribe, in general, to ‘ $\models \Delta A \vee \Delta \sim A$ ’: this fails for vague ‘ $A$ ’. Again, they maintain the principle of bivalence in full generality, ‘ $\models TA \vee T\sim A$ ’, where ‘ $T$ ’ is the truth operator, and the analogue of its necessitation, ‘ $\models \Delta(TA \vee T\sim A)$ ’; but for vague ‘ $A$ ’ we do not have ‘ $\models \Delta TA \vee \Delta T\sim A$ ’.<sup>7</sup>

Having at one stage endorsed something like this approach, Field subsequently criticized it on the grounds that it ‘seems to be an attempt to talk as if excluded middle were being restricted, without actually restricting it’ (2008, p. 155). But there is no equivocation: as we have just seen, the principles of excluded middle and of

<sup>2</sup> Stronger systems than KT are available, e.g. KTB, S4, or S5. Barnes and Williams (2011) favour S5 as their governing logic. Systems at least as strong as S4 do not permit higher-order vagueness: for discussion see Williamson (1994, pp. 157–161, 1999), Wright (1997, pp. 228–235), Keefe (2000, pp. 208–211), Shapiro (2006, Ch. 5), Bobzien and Rumfitt (2020). So far as I know, the position was first cast in the terms employed here (involving a modal logic weaker than S4) by Dummett in 1970 (1978, p. 257).

<sup>3</sup> Cf. Williamson (1994, p. 149). On supervaluationist approaches to vagueness, see Keefe (2000, Chs. 7 and 8), García-Carpintero (2010).

<sup>4</sup> Dummett (1978, p. 257).

<sup>5</sup> Note that, partly to accommodate the different vocabularies of writers in this area, I shall speak of the truth-value status sometimes of contextualized (indexed) declarative sentences, sometimes of statements (dated utterances of declarative sentences), and sometimes of propositions (the abstract referential meanings of declarative sentences). This variation will not affect my substantial points.

<sup>6</sup> For details see, e.g., Keefe (2000, pp. 174–181), Field (2008, pp. 150–155), Grandjean (2021, p. 1869).

<sup>7</sup> See here Barnes (2010, pp. 611–12, 620); cf. McGee (1989, p. 536).

bivalence are both said to be, and are, preserved. What does *not* go through is an inference from the determinate truth-value status of a disjunction to the determinate truth-value statuses of each of its disjuncts taken severally; but, in the case of vagueness, why should one expect that inference to succeed? (Observe that since we do not have, in general,  $\lceil A \models \Delta A \rceil$ ,<sup>8</sup> there is no need to restrict the Deduction Theorem, or the rules of *Vel* Elimination and *Reductio ad Absurdum*, and in general, as we have said, classical inference rules are maintained.)<sup>9</sup> To be clear: there is no question, on a classical indeterminist approach, of truth-value gaps or of a third truth-value: all statements are indeed—and are determinately—*either true or false*; but some statements, including vague ones, are not *determinately true* or *determinately false*.

Michael Dummett claimed—though so far as I can see he offers no argument—that for the principle of bivalence to hold generally it is not good enough for statements to be either true or false: they must be either determinately true or determinately false.<sup>10</sup> The issue is perhaps merely verbal, though from the point of view of terminological clarity it seems unattractive find oneself having to say that a position which holds every well-formed declarative sentence (with contextual parameters fixed) to be either true or false, and which preserves classical logic, nevertheless suspends bivalence. At any rate, for my purposes here the principle of bivalence will simply state that a declarative sentence—with contextual parameters fixed—is either true or false. That leaves open the possibility, exploited by the classical indeterminist, of saying that in individual cases it may be determinate that a given sentence takes one of these values, but not determinate which one. Since ‘determinately’ does not commute with disjunction, it does not commute with the existential quantifier, either: we have  $\exists \Delta \models \Delta \exists$ , but not  $\Delta \exists \models \exists \Delta$ . For example, in a sequence of colour samples shading from red to orange, while it is the case that, determinately, for some stage  $n$  the sample at that stage is red and the sample at stage  $n + 1$  is orange, there is no stage  $n$  such that, determinately, at that stage the sample is red and the sample at stage  $n + 1$  is orange.

On the classical indeterminist strategy, vagueness raises no difficulty for the Tarskian principle

(TP)  $S$  is true iff  $p$ ,

where  $S$  names (or describes) an object-language sentence and ‘ $p$ ’ holds place for a sentence in the metalanguage which gives its truth-conditions. If ‘ $p$ ’ on its right-hand side is vague, it is not either determinately true or determinately false, but it is still either true or false, and indeed, as we have said, determinately either true or false; the truth-value of the left-hand side will march in step with the value of ‘ $p$ ’, whatever it is (though of course that is not determinate). Formally, the position is

<sup>8</sup> McGee (1989, p. 537), Wright (1994, pp. 143–146). Cf. MacFarlane (2008, pp. 88–89).

<sup>9</sup> See Field (2008, p. 162).

<sup>10</sup> Dummett (1978, pp. 256–257, 1991, pp. 74–82, 1993, p. 56, 1995, p. 205). See also Wright (1987, p. 3, 1994, p. 145); Bobzien and Rumfitt (2020, §4).

similar to Timothy Williamson's approach to vagueness, but whereas in effect Williamson interprets the operator  $\Delta$  epistemically ('knowably'), the classical indeterminist interprets it metaphysically ('determinately').<sup>11</sup>

As I have said, at one stage Field favoured classical indeterminism. Later, he raised problems for it, and abandoned it for a non-classical strategy; Williamson advances similar arguments against classical indeterminism.<sup>12</sup> Both Williamson and (the later) Field think that, if  $\vDash A \vee \sim A$  holds—so that, given the analogue of necessitation,  $\vDash \Delta(A \vee \sim A)$  also holds, but not, in general,  $\vDash \Delta A \vee \Delta \sim A$ —it ought to be reasonable in a vague case, and notwithstanding the failure of  $\vDash \Delta A \vee \Delta \sim A$ , to speculate which of  $\vDash A$  or  $\vDash \sim A$  is true, seeing that one of them *is* true, and so also to wonder which of  $\vDash A$  and  $\vDash \sim A$  an omniscient (or a sufficiently superior) being would believe. Call this the Field–Williamson Argument.

Against the Field–Williamson Argument, as it is here deployed, one might respond on the classical indeterminist's behalf that the force of the claim that, for vague  $\vDash A$  and  $\vDash \sim A$ , we have  $\vDash \sim \Delta A \ \& \ \sim \Delta \sim A$  is that, though indeed *one* of  $\vDash A$  and  $\vDash \sim A$  is true, it is not determinate—so *not* reasonable to ask—which of them *is* true. A collection of sand-grains, for example, that is a borderline case of a heap will be determinately *either* a heap *or* not a heap, but, metaphysically, that is as far as we can go: the thing is not either *determinately a heap* or *determinately not a heap*. And for the question 'Is it a heap or not?' to be reasonable (answerable), the thing would have to be not merely either a heap or not a heap (which it is) but also either determinately a heap or determinately not a heap (which it is not). It is true, of course, that only determinate truths can be known, and it is also true, as we have noted, that the classical indeterminist position on vagueness is formally similar to epistemicism. Williamson thinks that the classical indeterminist's treatment of vagueness must, on pain of incoherence, collapse to epistemicism. But while the two positions are identical up until this last point, namely the interpretation of the ' $\Delta$ ' operator, it makes a difference whether we read this operator as meaning 'determinately' or 'knowably'. For 'determinately' and 'knowably' are not synonymous. Determinate truth connects with assertion in the same way as knowledge—that is, they both conform to the principle that one should assert only what one takes to be known (respectively, determinate) truths—and knowable truth entails determinate truth; but there is no reverse entailment.<sup>13</sup>

Williamson identifies a status, 'indefinitely true', which he thinks the classical indeterminist is required to find coherent, but which he then purports to reduce to absurdity: if something is true, it is true—so why not definitely true? (1994, p. 164). But for the classical indeterminist there is no metaphysical status—which, as it were, God can discern—of being true but not definitely true, as there *is* a status of being true but not knowably true. At least, there is no such status if (as Williamson intends) 'indefinitely true' is meant to rule out being false. In the case of

<sup>11</sup> See Williamson (1994, esp. ch. 7).

<sup>12</sup> See Field (2001, pp. 289–290, 2003, pp. 274–275, 281–282, 2008, pp. 151–153), Williamson (1994, esp. pp. 164, 194–195, 200–201, 1995, 1996, esp. pp. 43–45); also Fine (2017, pp. 3718–3719).

<sup>13</sup> Cf. Williamson (1995, p. 176).

vague  $\ulcorner A \urcorner$ , one of  $\ulcorner A \urcorner$  and  $\ulcorner \sim A \urcorner$  is true (and the other false) but it is indeterminate which way round it goes: as Jon Bornholdt puts it, indefinite truth is ‘irreducibly disjunctive’ (2017, p. 31). That is to say, there are not two mutually exclusive species of truth, definite and indefinite, which apply to *simple* statements considered in isolation from their negations: rather, ‘indefinitely true’ means ‘divides truth and falsity indefinitely with its negation’.<sup>14</sup> Put otherwise, you can if you like call a simple statement  $\ulcorner A \urcorner$  (respectively,  $\ulcorner \sim A \urcorner$ ) ‘indefinitely true’, but only if you simultaneously require the status of being indefinitely true to entail and be entailed by the status of being indefinitely false. This is a semantic version of the point that  $\ulcorner A \urcorner$  is borderline iff  $\ulcorner \sim A \urcorner$  is borderline.<sup>15</sup> For example, if Bill is borderline bald, we may say, if we wish, that he is indeterminately (indefinitely) bald, but only if we add that he is also indeterminately not bald. And, engaging in semantic ascent, we may say that ‘Bill is bald’ is indeterminately true, but only if we add that ‘Bill is not bald’ is also indeterminately true (equivalently: that ‘Bill is bald’ is also indeterminately false). ‘Indeterminately true (false)’ is inherently a complex—in particular, disjunctive—characterization that can be applied at the level of the simple statement only if the mutual entailment between indeterminate truth and indeterminate falsity, which encodes its disjunctiveness, is registered. By contrast, there is no implication that something which is unknowably true is also unknowably false; indeed, unless one is a dialetheist, one will wish to rule this option out. That appears to be a crucial structural difference between the two statuses.

Williamson’s epistemicist approach to vagueness seems to me subject to serious objections, some of which have been explored in the literature.<sup>16</sup> By comparison, classical indeterminism looks quite attractive. But it is not my purpose here to mount a full-scale defence of classical indeterminism as a strategy for dealing with vagueness. My aim in this section has been to set out the strategy in connection with vagueness (for which it was designed by its modern exponents), and to mention one prominent argument—the one I have called the Field–Williamson Argument—against it. As I have indicated, in my view this argument is, at least *prima facie*, unsuccessful against the classical indeterminist treatment of vagueness. But classical indeterminism, I shall suggest, is a much older position than a perusal of the modern literature on vagueness would lead one to suppose; and, against what I take to be the original application—still favoured by some philosophers—of classical indeterminism, namely to the problem of future contingency, it seems to me, and I shall argue in §3, that a version of the Field–Williamson Argument has considerable force.

<sup>14</sup> See Zimmermann (1981, p. lxxviii); Gaskin (1995, pp. 154–155).

<sup>15</sup> See Bobzien and Rumfitt (2020, §3).

<sup>16</sup> See here esp. Wright (1994, 2003, pp. 87, 90, 2007, pp. 424–425), McGee and McLaughlin (1998, pp. 232–233, 2004, pp. 123–124), Schiffer (1999), Keefe (2000, Ch. 3).

## 2 Future Contingency and ‘Classical Indeterminism’

The complex meaning of ‘indefinitely true’ that I discussed in the last section was in effect recognized by the Aristotelian commentators Ammonius and Boethius in their discussions of the sea battle problem as that figures in the ninth chapter of Aristotle’s *De Interpretatione*. (Here I shall largely focus on Boethius for convenience; Ammonius’ position is not significantly different.)<sup>17</sup> These commentators argue that, for Aristotle, a statement about a future contingency is indeed true or false, but not definitely true and not definitely false. As Boethius puts it, ‘the whole contradiction [‘There will be a sea battle tomorrow’/‘There will not be a sea battle tomorrow’] will indeed have one part true, the other false; but it will not be the case that one of those parts is definitely true, the other definitely false’ (1887–80, I. 123. 8–10). And we are told that the two members of such a contradiction do ‘divide’ the true and the false—one is true and the other false—but not in a definite way: ‘If I say “Philoxenus is going to dine”/ “Philoxenus is not going to dine”, in respect of the whole contradiction one [part] is indeed true, the other false, but no one can divide in such a way as to say either that the affirmation is constitutively and definitely (*constitute et definite*) true or that the negation is’ (ibid., I. 123. 18–22).<sup>18</sup> Similarly, in the case of a disjunction of contradictory future contingencies, the disjunction as a whole will be determinately true, but, though each disjunct has one of the two truth-values, and each disjunct takes the opposite truth-value from its co-disjunct, it is not determinate which disjunct has which truth-value.

I said that the commentators ‘in effect’ recognized the complex meaning of ‘indefinitely true’ that I argued for at the end of the last section; they do not do so explicitly. In fact, so far as I know they do not use the expressions ‘indefinitely true’ or ‘indefinitely false’ in the relevant sense (as applied to a simple statement about a future contingency) at all. This would be surprising if, as some modern critics have thought, they held indefinite truth and indefinite falsity to be modal statuses that could attach to a simple statement *in se*, that is, non-relationally. Mario Mignucci, for example, writes that, for the commentators, ‘the members of a pair of future contingent statements contradictorily opposed receive different truth-values, namely indefinite truth and indefinite falsity, which are opposed and mutually exclusive’.<sup>19</sup> This goes clean against my assertion at the end of §1 that if, in this context, we wish to talk of two statuses, indefinite truth and indefinite falsity, we must build into their semantics the fact that, far from being mutually exclusive, they are actually mutually entailing. But Mignucci’s interpretation of the commentators seems to me mistaken: as remarked, Ammonius and Boethius never use the phrases ‘indefinitely true’ and ‘indefinitely false’ in application to simple future contingent statements, as one would expect them to do if Mignucci were right; rather, they speak of pairs of contradictory statements as definitely or indefinitely dividing the true and the false. In other words, the relevant terminology is always used relationally: it is used in a

<sup>17</sup> See also Adamson (2006) on al-Fārābī’s similar approach.

<sup>18</sup> See also Boethius (1887–80, II. 208. 7–18; 245. 12–19).

<sup>19</sup> Mignucci (2001, pp. 252); see also Seel (2001, pp. 187, 189).

context where what is in question is the division of truth-values between the members of a pair comprising a declarative sentence and its negation. (That the language of division is to be so interpreted is reinforced by the fact that Boethius in one place glosses ‘definitely’ by ‘dividedly’, *divise*.)<sup>20</sup>

The passage from Boethius quoted above also illustrates the fact that it would be wrong to think that the commentators wished to restrict bivalence. Both Ammonius and Boethius are quite clear that statements about future contingencies *are* indeed true or false—but not determinately one or determinately the other. In other words, their treatment is a version of ‘classical indeterminacy’, as that was outlined in §1; indeed, they are, I suggest, among the earliest (extant) formulators of that position.

The commentators’ interpretation of Aristotle can be seen as steering a middle way between realist and anti-realist readings of him. According to the realist reading, Aristotle preserves bivalence about future contingent statements, but rejects any fatalistic entailment from the truth of such a statement to its necessity (in the sense of its unpreventability now); according to the anti-realist reading, Aristotle accepts the inference, urged by the fatalist, from the truth of a future contingent (indeed any) statement to its necessity (in the same sense: unpreventability now), but preserves the contingency of (at least part of) the future by restricting bivalence in respect of those statements about the future that treat of, especially, human deliberative action. The commentators, following a classical indeterminist strategy, read Aristotle as preserving an *unrestricted* principle of bivalence, but avoiding the intended aim of the fatalist’s entailment from truth to necessity by confining the source of that entailment to *determinate* truth (falsity); where the truth or falsity of a statement is *indeterminate*, as in the case of future contingencies, the entailment fails. If ‘indefinitely true’ denoted a way of being true, as conjectured by Williamson, then that entailment could not be blocked, and we would have to grapple with the curious statuses ‘indefinitely necessary’ and ‘indefinitely impossible’. Fortunately, however, we do not need to generate these puzzles for ourselves: although there is, for the Aristotelian commentators, an entailment from *divided* (definite, determinate) truth (falsity) to necessity (impossibility), there is no such entailment from *undivided truth and falsity*, since the latter is not a species of truth or of falsity, but a kind of metaphysical indecision between the two.

In an influential article Kretzmann (1998) sought to model the commentators’ interpretation of Aristotle by making a distinction between what he called ‘narrow’ and ‘broad’ bivalence. A similar approach, but with different terminology, has been recommended by MacFarlane (2003), as part of a systematic solution to the future contingency problem that I shall consider below.<sup>21</sup> The principle of narrow bivalence propounds bivalence as traditionally understood: it says that ‘at any given time any proposition has exactly one of these two truth-values, true or false’ (1998, p.

<sup>20</sup> Boethius (1887–80, I. 126. 7–8). Mignucci’s attempt to explain away this and similar pieces of evidence (2001, p. 252 n. 323) seems to me unconvincing.

<sup>21</sup> The positions advanced by Brogaard (2008) and Sweeney (2015), ostensibly as alternatives to MacFarlane’s (and by implication Kretzmann’s) position, seem to me to be notational variants thereof. See also Dummett (1981, pp. 391–400, 2008, pp. 129–130).

36). The principle of broad bivalence, which Kretzmann wishes to find in the commentators, says that '*for* any given time every proposition *eventually* has exactly one of these two truth-values, true or false' (ibid., my emphasis). It follows, we are told, that '*at* any time at which it does not *yet* have one of those truth-values [a proposition] has the disjunctive property either-true-or-false' (ibid., my emphasis). As the emphasized words indicate, we have to do here with a double indexing of propositions, namely to contexts of utterance and to contexts of assessment. According to the traditional view of propositional assessment, and according to the adherent of the doctrine of narrow bivalence, a proposition gets a single truth valuation no matter when it is assessed: that is to say, the truth-value of a contextualized sentence is determined by that sentence's (actual or presumptive) context of utterance, and the truth-value that it thereby acquires remains the same regardless of context of assessment. For the broad bivalentist, by contrast, a given proposition (equivalently: its governing sentence with indexical parameters fixed) may receive different truth-valuations depending on when it is assessed. For example, consider the proposition expressed by the sentence 'There will be a sea battle on 7 October 1571', as uttered on, say, 7 September 1571. (Pick any time before the Battle of Lepanto, which took place on 7 October 1571, became inevitable.) That proposition was, Kretzmann would say, true for 7 September at (from the point of view of) 7 November, whereas it was not true for 7 September at 7 September. MacFarlane would say that the proposition expressed by our sentence, as uttered on 7 September was neither true nor false, as assessed on that day, but that it was true as assessed on 7 November. Kretzmann interprets the commentators as saying that the utterance, as assessed when it was uttered, was either-true-or-false. Whichever terminological policy we follow, Kretzmann's or MacFarlane's, the broad bivalentist suspends narrow bivalence.

Now the commentators do not talk in this way, and Aristotle himself appears to reject any such double indexing. For he allows the fatalist to advance the argument that if it is true now to say that an object is white (now) then it was true to say that it would be white, in which case it was necessary that it would be white (*Int.* 18b9–11). Aristotle does not contradict this argument, and the implication is that he accepts it. He appears to see no difference between the fatalist's argument as embedded in the present and directed towards the future or as embedded in the past and directed towards the present. He makes no room, as the broad bivalentist does, for there to be a sense in which it is true that the Battle of Lepanto was going to happen before it happened—the Kretzmann sense, namely, in which it was true *for* those earlier times *at* suitably later times—but not true in such a way as to upset the contingency of the event; only future truth for an earlier time at that same time would do that, but this is precisely what, according to the broad bivalentist, we do not have. That means that Aristotle rejects the surely intuitive thought that, even if we allow that it was not true on 7 September 1571, *from the point of view of that day*, that there would be a sea battle in a month's time, nevertheless it *became* true *at sufficiently later times* that it had indeed been true on 7 September that there would be a sea battle in a month's time. Anyone who predicted, before 7 October, that a sea battle would occur on that day, would, as we say, have turned out to be right, and it is natural to suppose that there must at least be *a sense* in which what that person said was true at the time of utterance, not just later. It is this intuition that Kretzmann is



trying to accommodate with his distinction between truth for and truth at a time. As I have said, the exegetical problem he faces is that there appears to be no sign of this distinction in either Aristotle or his commentators. So it is easy to feel—and in the past I have thought—that the interpretation is a non-starter.<sup>22</sup>

But I now think that this conclusion would be too hasty. In the light of our earlier reflections on the idea of definiteness or determinacy, it can be seen that Kretzmann's line is, in itself, coherent, and is indeed merely a notational variant of a point that can be more clearly put in terms of the language of determinacy, so doing away with the clumsy (because linguistically unnatural) distinction between truth for and truth at a time. We can simply say that a proposition about a contingency, when assessed from the point of view of a suitably remote earlier time, was (is) indeed true or false, but not determinately true or determinately false. Assessed from the point of view of a sufficiently later time it turns out that the proposition was (say) true at that earlier time. It is *determinate* at that later time that the proposition *was* true at the earlier time, but we cannot commute the determinacy and tense operators and say that the proposition *was determinately* true at that earlier time. It was merely true. We can, if we like, import the language of 'indeterminately true' into the scenario and say that the proposition was indeterminately true then, but only if we recognize, as I have stressed (§1), that it was also indeterminately false then. It is not contradictory to say that the relevant proposition was, at the earlier time, all three of true, indeterminately true, and indeterminately false; or it might have been false, indeterminately false, and indeterminately true. Since it was indeterminate whether it was true or false then, it was indeterminate which of these conjunctions applied to it. Admittedly these conjunctions look odd, but, as Elizabeth Barnes and Ross Cameron note (2009, p. 298), the reason *why* they do so is that

(I)  $A \ \& \ \sim \Delta A$

cannot be determinately true. For, given that ' $\Delta$ ' distributes over '&', if as well as (I) we also have  $\ulcorner \Delta(A \ \& \ \sim \Delta A) \urcorner$ , we may infer  $\ulcorner \Delta A \ \& \ \Delta \sim \Delta A \urcorner$ , which in turn, applying the analogue of the T-axiom to the second conjunct, yields a contradiction. (I) can be *true* at a time, and as we have said it can later become *determinately* true that (I) *was* true at that earlier time, but that is all. We cannot commute the modality and tense operators and infer that, at the later time, (I) *was determinately* true at the earlier time.

In itself, then, the position I have just characterized is coherent, and equivalent to Kretzmann's interpretation of the Aristotelian commentators. We said that it told against Kretzmann that Aristotle and his commentators appear to evince no awareness of double indexing. But perhaps if the position is recast along the lines of the last paragraph, using the language of determinacy, it can do better as an interpretation either of Aristotle or of his commentators, or both. When one looks again at *Int.* 18b9–11 and the commentaries on that passage, it is striking that, in considering a future contingent statement as assessed from a time later than the predicted event,

<sup>22</sup> Gaskin (1995, pp. 176–179).

both Aristotle and his commentators talk not about the sheer *truth-value* of the earlier statement, but about the status of an *assertion* of it. The claim that the fatalist is made to lodge, and which is supported by Aristotle and his commentators, is that if it was *true to say* that a given object would be white, then it was also, then, *necessary* that it would be white. And Boethius goes to some trouble to argue that in asserting something, unless you explicitly signal otherwise, you are committed to the necessity of what you assert; hence for Boethius, the sheer assertion of ‘There will be a sea battle in a month’s time’, made on 7 September 1571, is false, because it is tantamount to the assertion that there will *necessarily* be a sea battle in a month’s time, and *that* is false.<sup>23</sup> Boethius does not explicitly say that in asserting that *p* you are in effect asserting that it is *determinately true* that *p*, but I suggest that the most natural way to read him is to presuppose that gloss, and construe him as then applying an entailment from determinate truth to necessity. This would enable him to infer, as he wishes to do, that, where the content of an assertion has to do with a future contingency, in asserting that *p* you are in effect asserting, falsely, that it is necessary that *p*. It follows that (I) can be true but not truly assertible.<sup>24</sup> For to assert (I) would be to assert  $\ulcorner \Delta(A \ \& \ \sim \Delta A) \urcorner$ , and this, as we have seen, cannot hold on pain of contradiction. Relevant modal and tense operators do not commute, so that, taking ‘*P*’ as the past-tense operator, while one can truly prefix ‘ $\Delta P$ ’ to (I), to yield  $\ulcorner \Delta P(A \ \& \ \sim \Delta A) \urcorner$ , one cannot consistently move from there to  $\ulcorner P\Delta(A \ \& \ \sim \Delta A) \urcorner$ .

The commentators, I have said, plot a middle path between anti-realist and realist interpretations of Aristotle. Against anti-realist interpretations, bivalence is fully preserved, and the fatalist’s entailment from truth to necessity blocked by restricting the source of that entailment to determinate truth; against realist interpretations, a distinction is drawn between truth *simpliciter* and *determinate* truth, and it is allowed that the latter status entails necessity. On the commentators’ approach, while determinate truth is a quite distinct status from determinate falsity, with the former taken to entail necessity and the latter impossibility, the indeterminate truth and indeterminate falsity of simple statements (if we wish to accommodate such statuses) are mutually entailing, and carry no necessitarian implications. Modern writers are agreed that ‘definitely’ and its congeners, as used by Ammonius and Boethius, are not *synonymous* with ‘necessarily’: rather, there is supposed to be an *entailment* between definite or divided truth/falsity and necessity/impossibility.<sup>25</sup> Still, one might wonder what exactly would be lost by reading ‘definitely *p*’ as meaning ‘necessarily *p*’. Well, we hit a problem over ‘indefinitely’: for this is neither the contradictory nor the dual of ‘definitely’. Rather, it is the conjunction of both: ‘indefinitely *p*’, if one permits oneself to talk thus, has to mean ‘not definitely *p* and not definitely not-*p*’. And in that case ‘indefinitely *p*’ and ‘indefinitely not-*p*’ are at some level synonymous: they both mean ‘indefinite whether or not *p*’. One could interpret ‘indefinitely’ as ‘contingently’, provided one insisted on a mutual entailment between ‘contingently *p*’ and ‘contingently not-*p*’. This would work in an

<sup>23</sup> See Boethius (1887–80, II. 211. 29–213.18). So too MacFarlane: see §3 below.

<sup>24</sup> See here again Barnes and Cameron (2009, p. 298 n. 21).

<sup>25</sup> Gaskin (1995, p. 154), Mignucci (2001, p. 267 n. 369), Seel (2001, p. 243 n. 297).

object language containing no semantic vocabulary, but in normal usage there is no entailment from ‘contingently true’ to ‘contingently false’ or vice versa, since these appellations are taken to entail truth and falsity respectively.

### 3 Comparison Between the Two Cases

I shall now argue that the doctrine of classical indeterminism works less well—ironically enough, in view of its historical provenance—in the case of future contingency than it promised to do in the case of vagueness. Recall the Field–Williamson argument against the deployment of classical indeterminism to deal with vagueness, namely that, for vague  $\ulcorner A \urcorner$  and  $\ulcorner \sim A \urcorner$ , it ought to be reasonable to wonder which of them is true, given that, according to the classical indeterminist, one of them *is* true. The indeterminist’s reply was that the force of the claim that, for vague  $\ulcorner A \urcorner$  and  $\ulcorner \sim A \urcorner$ , we have  $\ulcorner \sim \Delta A \ \& \ \sim \Delta \sim A \urcorner$  is that, though indeed *one* of  $\ulcorner A \urcorner$  and  $\ulcorner \sim A \urcorner$  is true, it does *not* make sense to ask which: a pile of grains of sand (say) that is a borderline case of a heap is *either* a heap *or* not a heap, and indeed determinately so, but it is not *either determinately a heap or determinately not a heap*. Turning to the case of future contingents, a classical indeterminist would say that (the proposition expressed by) a future contingent statement, such as ‘A sea battle will take place tomorrow’, is indeed either true or false, today, but that it is not, today, determinately true or determinately false; the proposition expressed by that statement, made today, *becomes* determinately true or determinately false tomorrow. The transposed Field–Williamson objection now runs: ‘But if the relevant proposition is either true or false today, even if it is not today either determinately true or determinately false, you can still intelligibly wonder which of the two permitted options (true and false) it is’.

In its new context the Field–Williamson objection is, it seems to me, a good one. For it surely *does* make sense to ask, concerning a future contingency, and regardless of one’s views on the semantics of relevant statements, whether the relevant event *really will* occur or not. Whereas in the heap case one might say that an indeterminacy *remains* an indeterminacy over time, so long as the heap itself stays unchanged, in the case of a future contingency, by contrast, the mere passage of time (as we loosely put it) renders the proposition expressed today by ‘There will be a sea battle tomorrow’ determinately true or determinately false. And at the time when that proposition becomes determinately true or determinately false, it will either be determinate that it was true (today) or determinate that it was false (today).<sup>26</sup>

Of course, as we have seen, the classical indeterminist bars any future retrojection of that determinacy to the present: we have  $P\Delta \vDash \Delta P$ , but not  $\Delta P \vDash P\Delta$ . Still, although I cannot truly say today that it is determinately true that there will be a sea battle tomorrow or truly say that it is determinately false there will be one, it remains the case that it *is* true or false that there will be one; it ought, then, to make sense to wonder whether there *will be* a sea battle tomorrow or not. And to be fobbed off

<sup>26</sup> Cf. Barnes and Cameron (2011, pp. 3–6), Grandjean (2021, p. 1878).

with the response ‘Yes, the proposition is indeed either true or false now, but it’s indeterminate which, so your wondering makes no sense’ seems unsatisfactory. In a well-known passage David Lewis gives expression to the operative intuition here:

The trouble with [the idea of] branching [time] exactly is that it conflicts with our ordinary presupposition that we have a single future. If two futures are equally mine, one with a sea fight tomorrow and one without, it is nonsense to wonder which way it will be—it will be both ways—and yet I do wonder. (1986, pp. 207–8)

Note that, in saying ‘it will be both ways’, Lewis plainly does not intend to assert a contradiction (as MacFarlane supposes: 2014, p. 233): we have a compendious expression for ‘There are sea battles on some future branches and not on others’. The availability of future-oriented propositional attitudes, such as wondering, hoping, or fearing, seems to require that the propositional object of the attitude have a *determinate* truth-value now. That is because you cannot (for example) fear that something will occur tomorrow without fearing that it is *true* that it will occur tomorrow, which in turn requires a firmer conception of future truth (falsity) to be in place, now, than the classical indeterminist’s ‘either-true-or-false’.

Again, if you predict that there will be a sea battle tomorrow, and if your prediction turns out, as we say, to be right, it seems unsatisfactory to attempt to accommodate our intuitions by some such manoeuvre as the assurance that (in Kretzmann’s terminology) ‘You were not right for the time when you made the predication *at* that time, but (it has turned out that) you were right for that time *now*’. Surely you were just right, period. Supporters of double-indexing want there to be a *sense* in which it is *also* correct to say, now, when the sea battle is raging, that your earlier prediction of a sea battle today was not yet true, or not yet determinately true, or something of the sort; but I suggest that, ordinarily, we do not allow there to be such a sense. The event is a contingency, so your forecast was only contingently true, but it was, nevertheless, true *simpliciter*, and determinately so. We did not know of its truth at the time, and perhaps we could not have known that, because it may be that knowledge of the future, insofar as we have it, works by tapping into necessary processes and extrapolating therefrom. Even so, there is a clear pull towards saying that your prediction was in fact right, albeit contingently so.<sup>27</sup>

Indeed, it is even the case that there is no reason why anyone should have cared *at the time* of your prediction that it was not then true *for* that time, in Kretzmann’s sense. To put it in Kretzmann’s terms, you were not (or not merely) aiming to say something that was true for that time *at* that time, but something that would (turn out to) be true for that time at the relevant later time (the time that the prediction concerned). But then, of course, if your assertion *was going* to be true, later, *for* the time of utterance—if it was true that your assertion would turn out to be true—what serious room is left for saying that it was nevertheless not true for that time *at* that

<sup>27</sup> Cf. Prior (1967, p. 131), Wright (1980, pp. 170–1).

time?<sup>28</sup> What would that claim mean, and again, whatever it means, why should anyone care about it? We have here a point made by Evans (1985, pp. 349–50): the aim of assertion is to express propositions that are true—true absolutely, not merely true at one moment of assessment but possibly not true at another such moment. MacFarlane suggests that, if Jake utters ‘There will be a sea battle tomorrow’ and is challenged on the grounds that ‘it is not yet settled whether there will be a sea battle,’ then ‘Jake will not be able to meet the challenge, and he will be obliged to withdraw his assertion’.<sup>29</sup> (By ‘settled’ MacFarlane means ‘determined’, ‘inevitable’: 2008, p. 85.) But Jake did not assert that it was *settled* (necessitated) that there would be a sea battle; he just forecast that there would be one. Asked for his grounds, he might reply: ‘I haven’t got any, at least, not any scientifically respectable grounds; I just have a hunch that it’s true’.<sup>30</sup> But if a sea battle occurs, then he *was right*. It is not merely that, as Gilbert Ryle says, his guess ‘would have *turned out* correct’ later—if by that we mean to leave room for its not having been correct at the time (in any sense).<sup>31</sup> No: if it *turns out to be* correct, then it *was* correct. ‘Your prediction has turned out to be correct’ means not that your prediction has changed status from incorrect (then) to correct (now), but rather that it now transpires (has become clear) that the prediction was correct at the time it was made.

Fatalists think that, in some sense, truth entails necessity. If we articulate this sense into two purported sub-entailments, one from truth to determinate truth, followed by another from determinate truth to necessity, then we obtain two points at which a realist about the future can resist the overall derivation. Boethius accepts the second sub-entailment, from determinate truth to necessity, and so must reject the first one, from truth to determinate (definite) truth, if he is to preserve the contingency of the future—given in addition, as I have suggested, that he does not wish to suspend the principle of bivalence (which would be the anti-realist’s way of maintaining future contingency). And this is just what he does.<sup>32</sup> On this approach, one has to bite the bullet over the worry which exercises Lewis, and say that it does *not* make sense to wonder whether (hope that, fear lest, etc.) there will *in fact*, albeit merely contingently, be a sea battle tomorrow: the answer to any such speculation will be that on some branches of time’s tree there are sea battles and on others there are not, with nothing more to be said. But we knew that much already when we inserted the rider ‘merely contingently’ into our expression of wondering. If, however, one is both a realist about the future and thinks that an act of wondering (hoping, fearing) directed at a future contingency *does* make sense, then the purported derivation of necessity from truth, via determinacy, should be broken at its second

<sup>28</sup> Some philosophers try to answer this question by deploying a notion of *grounding*: see, e.g., Correia and Rosenkranz (2018, Ch. 7). That strategy seems to me to fall foul of standard objections to the correspondence theory of truth, as I have detailed elsewhere: see Gaskin (2020, §30).

<sup>29</sup> MacFarlane (2003, p. 335; cf. 2008, pp. 90–1).

<sup>30</sup> The adjustments to his position that MacFarlane considers at (2014, pp. 230–232), still do not address this important objection.

<sup>31</sup> Ryle (1969, p. 23) (my emphasis); cf. Grandjean (2021, p. 1867).

<sup>32</sup> So too Barnes and Cameron (2011, pp. 23–4), who argue that the fatalist’s inference from truth to necessity only goes through (but that it does go through) for *determinate* truth.

sub-entailment. It may be true, and determinately true, that there will be a sea battle tomorrow; but it does not follow that it is necessary. Here, against Aristotle (perhaps), Boethius (certainly), and some modern philosophers, including MacFarlane, we insist that there is no entailment from truth—even from determinate truth—to necessity.

MacFarlane's position is fatalistic in that he thinks there is an entailment from truth to necessity. ('Present claims concerning the future can be shown to be untrue by a proof of present unsettledness'.)<sup>33</sup> He rejects the 'Thin Red Line' (TRL)<sup>34</sup> doctrine of a path in the branching tree of time that is metaphysically privileged, singled out in advance, as being *the* actual future in an absolute sense. Rather, he takes 'actual' to be a pure indexical: relative to each branch of the tree, the world of that branch is actual, and no timeline is privileged over any others or distinguished as being the *real* course of events. As Lewis notes, there is something quite disturbing about this idea, though you might also say that its egalitarianism is Lewisian in spirit.<sup>35</sup> Consider the following dialogue

- A I predicted yesterday that there would be a sea battle today. As you see a sea battle is taking place. So I was right.
- B Well, as it happens we are on a branch of time's tree where a sea battle takes place today. But there are other branches leading off from your forecast yesterday where sea battles are not taking place today, and on those branches you (or your counterparts) were wrong.
- A Yes, but those are merely counterfactual branches, and I wasn't talking about *them*. The one we're on is the actual branch, and that's the one I meant.
- B They (you or your counterparts) can say as much on the other branches. Many of them *are* currently saying it.
- A Sure, but the difference is that I'm (really) *right*, and they're (really) *wrong*. My world is real; their worlds are not.
- B That's just what they're saying, too, of their own worlds. Who's to choose? What makes *this* world special?

*B* concedes that, relative to the branch they are on, *A* was right, but not that *A* was absolutely right.

I suggest that we are deeply conflicted on the difficulty that is raised here. In some moods we suppose that *this* world is uniquely real, with a single future, albeit (probably) an unsettled (undetermined) one. In these moods we reject the fatalist's inference from truth to necessity, and allow a prediction to be simply (determinately) true, but also contingent. The future *could* be otherwise; it is just that it *will not* be. Indeed, the TRL itself could be otherwise than it is: in some contexts we must evaluate *counterfactual* TRLs, which has the consequence that we need a TRL for *every*

<sup>33</sup> MacFarlane (2008, p. 90). Cf. Iacona (2013, pp. 34–35). Wilson (2017, p. 114).

<sup>34</sup> The name comes from Belnap and Green (1994, p. 366); but they were anticipated by Prior: see Øhrstrøm (2014, p. 181).

<sup>35</sup> On the indexicality of 'actual', see Lewis (1983, pp. 18–20).

point in the tree. Alternatively expressed, we may say that how things would go or would have gone is determinate for each choice point; in effect we here subscribe to the ontological correlate of Molina's doctrine of middle knowledge and say that subjunctive conditionals have determinate truth-values.<sup>36</sup> In other moods, we adopt a more objective, god-like stance and think of possible worlds, with their proprietary histories, in an egalitarian way, as being all equally real. In these moods we are sympathetic to the fatalist's inference from truth to necessity: we say that purportedly possible futures which are not distinguished as actual by the TRL are not really possible after all,<sup>37</sup> and that if there *is going to be* a sea battle tomorrow, then there *must be* one. The inference from the first of these two emphasized phrases to the second has generally been considered fallacious, but as Dummett observed we do seem to apply a version of the same inference to our reasoning about *the past*—we think that the past is now non-negotiable *because* it is stocked with facts (truths)—so why not also to our thinking about the future?<sup>38</sup>

I am not here going to attempt a resolution of the inconcinnity between these perspectives. My point is that the classical indeterminist strategy, though perhaps serviceable in helping to model vagueness, is of no assistance in the case of future contingency, despite the fact that it was originally constructed with exactly this application in mind. Its unsatisfactoriness in the domain for which it was intended is essentially a consequence of the point about propositional attitudes. The act of wondering, for example, engages with determinate truth in the following sense: to wonder whether *p* is to wonder whether it is *determinately true* that *p*, and similarly for hoping, fearing, etc.<sup>39</sup> Field and Williamson are right to imply that *if* it made sense to wonder, in a vague and borderline case, whether this small pile of salt in front of me was *really* a heap, then the classical indeterminist position *would be* untenable: it would collapse to epistemicism, or triviality. That is, if we wished to continue to insist on the failure, in general, of  $\ulcorner A \models \Delta A \urcorner$ , the 'determinately' operator would have to mean 'knowably', or something of the sort; if, on the other hand, we accepted  $\ulcorner A \models \Delta A \urcorner$ , triviality would ensue.<sup>40</sup> As we saw, the classical indeterminist countered that it *does not make sense* to wonder in a borderline case—a case we take to be indeterminate—whether the relevant object is *really* on one side of the line or is *really* on the other. Be that as it may, I suggest that it evidently *does* make sense to wonder whether a sea battle, though a contingency, *really will* occur tomorrow or not; and since in so wondering I am wondering whether it is now determinately true that there will be a sea battle tomorrow, or now determinately false that there will be, it follows that classical indeterminism cannot coherently be maintained for future contingencies. For if I knew today that, as the classical indeterminist urges,

<sup>36</sup> See Gaskin (2000); cf. Øhrstrøm (2014, pp. 183–187). This observation addresses a problem raised by MacFarlane and others: MacFarlane (2014, pp. 210–211); cf. Belnap and Green (1994, pp. 379–381).

<sup>37</sup> Cf. MacFarlane (2003, p. 325).

<sup>38</sup> Dummett (1978, pp. 338–389). This problem exercised a number of later medieval thinkers, including Gregory of Rimini and Peter of Ailly: for discussion and further references see now Schabel (2019).

<sup>39</sup> This point is overlooked by Barnes and Cameron in their (2011), at pp. 19–22, where they attempt to reconcile classical indeterminism with the holding of various cognitive attitudes towards the future.

<sup>40</sup> On this point see, e.g., Hughes and Cresswell (1968, p. 65).



it was not today *determinately* true that there would be a sea battle tomorrow, it would then make no sense for me to wonder whether it was nevertheless *simply true* that there would be one. That is, this act of wondering would make no sense *unless* ‘determinately’ had lost the distinctive meaning that classical indeterminism gives it, in which it applies to pairs of contradictory opposites and means ‘dividedly’, and instead applied to simple statements *in se* and meant ‘knowably’ or ‘necessarily’ (‘now unpreventably’).<sup>41</sup> If this reasoning is correct, it leaves us with the unappealing choice between an anti-realism about the future that frankly suspends bivalence, but which cannot accommodate our future-oriented propositional attitudes, on the one hand, and a realism, on the other, which maintains bivalence and preserves future contingency by severing the fatalist’s inference from truth to necessity, but which cannot explain the fact that we find the fatalist’s inference unproblematic when it is swung round and directed towards the past.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Adamson, P. (2006). The Arabic sea battle: Al-Fārābī on the problem of future contingents. *Archiv Für Geschichte Der Philosophie*, 88, 163–188.
- Barnes, E. (2010). Ontic vagueness: A guide for the perplexed. *Noûs*, 44, 601–627.
- Barnes, E., & Cameron, R. (2009). The open future: Bivalence, determinism, and ontology. *Philosophical Studies*, 146, 291–309.
- Barnes, E., & Cameron, R. (2011). Back to the open future. *Philosophical Perspectives*, 25, 1–26.
- Barnes, E., & Cameron, R. (2017). Are there indeterminate states of affairs? No. In E. Barnes (Ed.), *Current controversies in metaphysics* (pp. 120–131). Routledge.
- Barnes, E., & Williams, R. (2011). A theory of metaphysical indeterminacy. *Oxford Studies in Metaphysics*, 6, 103–148.
- Belnap, N., & Green, M. (1994). Indeterminism and the thin red line. *Philosophical Perspectives*, 8, 365–388.
- Blank, D. and Kretzmann, N. (eds.) (1998). *Ammonius on Aristotle on interpretation 9 with Boethius on Aristotle on interpretation 9*. London: Duckworth.
- Bobzien, S., & Rumfitt, I. (2020). Intuitionism and the modal logic of vagueness. *Journal of Philosophical Logic*, 49, 221–248.
- Boethius, A. M. S. (1887–80). *Commentarii in Librum Aristotelis De Interpretatione*, editio prima et secunda, ed. C. Meiser. Leipzig: Teubner.
- Bornholdt, J. (2017). *Walter chatton on future contingents*. Brill.
- Brogaard, B. (2008). Sea battle semantics. *Philosophical Quarterly*, 58, 326–335.

<sup>41</sup> See here MacFarlane (2008, p. 97).



- Correia, F., & Rosenkranz, S. (2018). *Nothing to come: A defence of the growing block theory of time*. Springer.
- Dummett, M. (1978). *Truth and other enigmas*. Duckworth.
- Dummett, M. (1981). *Frege: Philosophy of language*. Duckworth.
- Dummett, M. (1991). *The logical basis of metaphysics*. Cambridge: Harvard University Press.
- Dummett, M. (1993). *The seas of language*. Clarendon Press.
- Dummett, M. (1995). Bivalence and vagueness. *Theoria*, 61, 201–216.
- Dummett, M. (2008). Truth from the constructive standpoint. *Theoria*, 64(2–3), 122–138.
- Eklund, M. (2002). Inconsistent languages. *Philosophy and Phenomenological Research*, 64, 251–275.
- Evans, G. (1985). *Collected papers*. Clarendon Press.
- Field, H. (2001). *Truth and the absence of fact*. Clarendon Press.
- Field, H. (2003). The Semantic Paradoxes and the Paradoxes of Vagueness. In J. Beall (Ed.), *Liars and Heaps (OUP)* (pp. 262–311).
- Field, H. (2008). *Saving truth from paradox*. OUP.
- Fine, K. (2017). The possibility of vagueness. *Synthese*, 94, 3699–3725.
- García-Carpintero, M. (2010). Supervaluationism and the report of vague contents. In R. Dietz & S. Moruzzi (Eds.), *Cuts and clouds: Vagueness, its nature, and its logic* (pp. 345–359). OUP.
- Gaskin, R. (1995). *The Sea Battle and the master argument: Aristotle and Diodorus Cronus on the metaphysics of the future*. De Gruyter.
- Gaskin, R. (2000). Conditionals of freedom and middle knowledge. In E. Dekker (Ed.), *Middle knowledge* (pp. 137–156). Lang.
- Gaskin, R. (2020). *Language and world: A defence of linguistic idealism*. Routledge.
- Grandjean, V. (2021). How is the asymmetry between the open future and the fixed past to be characterized? *Synthese*, 198, 1863–1886.
- Hughes, G., & Cresswell, M. (1996). *A new introduction to modal logic*. Routledge.
- Iacona, A. (2013). Timeless Truth. In F. Correia & A. Iacona (Eds.), *Around the tree: Semantic and meta-physical issues concerning branching and the open* (pp. 29–45). Springer.
- Keefe, R. (2000). *Theories of vagueness*. CUP.
- Kretzmann, N. (1998). Boethius and the truth about tomorrow's sea battle. In: Blank and Kretzmann (pp. 24–52).
- Lewis, D. (1983). *Philosophical papers* (Vol. 1). OUP.
- Lewis, D. (1986). *On the plurality of worlds*. Blackwell.
- MacFarlane, J. (2003). Future contingents and relative truth. *Philosophical Quarterly*, 53, 321–336.
- MacFarlane, J. (2008). Truth in the garden of forking paths. In M. García-Carpintero & M. Kölbel (Eds.), *Relative truth* (pp. 81–102). OUP.
- MacFarlane, J. (2014). *Assessment sensitivity: Relative truth and its applications*. OUP.
- McGee, V. (1989). Applying Kripke's theory of truth. *Journal of Philosophy*, 86, 530–539.
- McGee, V. (1991). *Truth, vagueness, and paradox: An essay on the logic of truth*. Hackett.
- McGee, V. (2005). A semantic conception of truth? and 'afterword.' In B. Armour-Garb & J. Beall (Eds.), *Deflationary truth* (pp. 111–152). Open Court.
- McGee, V., & McLaughlin, B. (1995). Distinctions without a difference. *Southern Journal of Philosophy*, 33(Supplement), 203–251.
- McGee, V., & McLaughlin, B. (1998). 'Review of T. Williamson, vagueness.' *Linguistics and Philosophy*, 21, 221–235.
- McGee, V., & McLaughlin, B. (2004). Logical commitment and semantic indeterminacy: A reply to Williamson. *Linguistics and Philosophy*, 27, 123–136.
- Mignucci, M. (2001). Ammonius and the problem of future contingent truth. In: Seel (pp. 247–84).
- Øhrstrøm, P. (2014). What William of Ockham and Luis de Molina would have said to Nuel Belnap: A discussion of some arguments against "the thin red line." In T. Müller (Ed.), *Nuel Belnap on indeterminism and free action* (pp. 175–190). Springer.
- Prior, A. (1967). *Past, present, and future*. Clarendon Press.
- Ryle, G. (1969). *Dilemmas: The Tarner Lectures 1953*. CUP.
- Schabel, C. (2019). Redating Pierre D'Ailly's early writings and revisiting his position on the necessity of the past and the future. In J.-P. Boudet, M. Brünzei, F. Delivré, H. Millet, J. Verger, & M. Zink (Eds.), *Pierre d'Ailly. Un esprit universel à l'aube du XVIe siècle* (pp. 61–82). Paris: Académie des Inscriptions et Belles-Lettres.
- Schiffer, S. (1999). The epistemic theory of vagueness. *Philosophical Perspectives*, 13, 481–503.
- Seel, G. (Ed.). (2001). *Ammonius and the Sea Battle: Text, commentary, and essays*. De Gruyter.

- Shapiro, S. (2006). *Vagueness in context*. Clarendon Press.
- Sweeney, P. (2015). Future contingents, indeterminacy, and context. *Pacific Philosophical Quarterly*, 96, 408–422.
- Williamson, T. (1994). *Vagueness*. Routledge.
- Williamson, T. (1995). Definiteness and knowability. *Southern Journal of Philosophy*, 33(S1), 171–192.
- Williamson, T. (1996). Wright on the epistemic conception of vagueness. *Analysis*, 56, 39–45.
- Williamson, T. (1999). On the structure of higher-order vagueness. *Mind*, 108, 127–143.
- Wilson, J. (2017). Are there indeterminate states of affairs? Yes. In E. Barnes (Ed.), *Current controversies in metaphysics* (pp. 105–119). Routledge.
- Wright, C. (1980). *Wittgenstein on the foundations of mathematics*. Duckworth.
- Wright, C. (1987). Dummett and Revisionism. In B. Taylor (Ed.), *Michael Dummett: contributions to philosophy* (pp. 1–30). Martinus Nijhoff.
- Wright, C. (1994). The epistemic conception of vagueness. *Southern Journal of Philosophy*, 33(Supp), 133–59.
- Wright, C. (1997). Further reflections on the Sorites paradox. In R. Keefe & P. Smith (Eds.), *Vagueness: A reader* (pp. 204–250). Cambridge: MIT.
- Wright, C. (2003). Vagueness: A fifth-column approach. In J. Beall (Ed.), *Liars and heaps: New essays on paradox* (pp. 84–105). Clarendon Press.
- Wright, C. (2007). “Wang’s Paradox.” In R. Auxier & L. Hahn (Eds.), *The philosophy of Michael Dummett* (pp. 415–444). Open Court.
- Zimmermann, F. (1981). *Al-Farabi’s commentary and short treatise on Aristotle’s De Interpretatione*. Clarendon Press.

**Publisher’s Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.