THE PROBLEM OF FUTURE CONTINGENTS

ROCZNIKI FILOZOFICZNE
Tom LXVI, numer 4 – 2018
ENGLISH ONLINE VERSION
DOI: http://dx.doi.org/10.18290/rf.2018.66.4-1en

MARCIN TKACZYK

THE ANTINOMY OF FUTURE CONTINGENT EVENTS

Antinomy is here understood as a proof that a theory is contradictory, while the name of a paradox belongs to a proof of any unexpected or undesirable theorem. Thus, the concept of antinomy is narrower than that of paradox. For instance, quantum effects are paradoxical because they clash with everyday experience, but they do not lead to an antinomy, since they find consistent explanation within quantum mechanics. The following work is concerned with analyzing and solving, i.e. removing, an antinomy which has been a subject of debate from the antiquity up to the contemporary time. The antinomy in question has been known as *the problem of future contingent events*, *the problem of future contingents*, *the problem of tomorrow's sea battle*, the problem of Diodorus Cronus, *the problem of divine foreknowledge and free will*, the problem of logical determinism, etc. The existence of so many names for it is connected to the diversity of its presentations, all falling under the same scheme. The following account is based, to a significant degree, on the earlier book (Tkaczyk 2015), though it modifies some of the points made there.

THE SCHEME OF THE ANTINOMY OF FUTURE CONTINGENTS

As we will see, the antinomy of future contingents is a scheme of many antinomies, which pose a danger to different theories, rather than a single antinomy.

Prof. dr hab. Marcin Tkaczyk — Katedra Logiki na Wydziale Filozofii KUL; adres do korespondencji: Al. Racławickie 14, 20-950 Lublin; e-mail: tkaczyk@kul.pl. ORCID: https://orcid.org/0000-0003-0380-7072.

In the account proposed here, it constitutes a trilemma. The first two premises are more or less the same in all the variants of the antinomy, while the third premise is the scheme of different theses characteristic for its different versions. Thus, the antinomy of future contingents is based on three assumptions:

every past state of affairs is determined, (1)
at least some future states of affairs are contingent, (2)
every state of affairs can be represented at any time. (3)

As has already been said, assumptions (1) and (2) are present in every version of the antinomy of *future contingents* . They express a certain anisotropy or asymmetry of the universe of states of affairs in terms of the temporal relations defined in that universe. The assumption (3) takes different forms, leading to different versions of the antinomy. (3) concerns the possibility of representing, projecting, or mapping out, i.e. reflecting, of some states of affairs by others. The assumption (1) is called the closed past assumption, (2) is known as the open future assumption, and (3) can be called the representation assumption.

Terms such as "state of affairs" or "event" are used synonymously here. States of affairs are understood to be able to occur (exist) or not occur (not exist). For instance, both "Brutus killed Caesar" and "Brutus did not kill Caesar" are states of affairs, though the former occurred and the latter did not.

Assumptions (1) and (2) concern temporal and modal characteristics of the universe of states of affairs. The following temporal relations are defined in the universe:

a state of affairs x is earler then a state of affairs y, (4a)
a state of affairs x is later then a state of affairs y, (4b)
a state of affairs x is simultaneous with a state of affairs y. (4c)

Out of the relations above, the first and the second one are converses of each other. With reference to a given state of affairs x all states of affairs earlier than x are past, all states of affairs later than x are future, and all states of affairs simultaneous with x are present. Thus, one can talk about —respectively— the past, the present, and the future with reference to event x. Apart from temporal relations, the following modal relations are defined in the universe of states of affairs:

a state of affairs x is necessary with reference to a state of affairs y, (5a)
a state of affairs x is impossible with reference to a state of affairs y, (5b)
a state of affairs x is contingent with reference to a state of affairs y, (5c)

and the modal relation

a state of affairs x is determined with reference to state of affairs y. (5d)

which constitutes the sum of the relation of necessity (5a) and the relation of impossibility (5b). A state of affairs which has to occur, i.e. whose occurrence is necessary, is called necessary. A state of affairs which cannot occur, i.e. whose occurrence is impossible, is called impossible. A state of affairs which is either necessary or impossible is called determined. A state of affairs which is not determined, i.e. can occur or not occur—both its occurrence and non-occurrence are possible—is called contingent.

Modal terms "necessary," "impossible," "determined," and "contingent" are known to take different meanings. Within the framework of the problem of *future contingents*, they are understood in such a way that necessity, impossibility, determination and contingency are modal relations between states of affairs. Because of the relative character of modality, the same state of affairs can have different modal characteristics in relation to different states of affairs—depending, among other things, on time. For example, as known from the Bible (Genesis 27), Isaac was allowed to impart a one- and only one-time special blessing, connected to an investiture of a sort and making the receiver God's chosen one. Isaac intended to impart the blessing to his eldest son, Esau, but, as a result of a ruse, unconsciously blessed Jacob, the younger son. Before Jacob bilked Esau out of the blessing, Isaac could bless Jacob and he could bless Esau: imparting a blessing on Esau and imparting it on Jacob were contingent events or contingent states of affairs. However, when Isaac had already blessed Jacob, imparting a blessing on Jacob became a necessary event – and, since he was allowed to impart it only once, imparting it on Esau became an impossible event. A state of affairs x is necessary, impossible, determined or contingent with reference to a state of affairs y if and only if the occurrence of x is, respectively, necessary, impossible, determined or contingent in y. In the state of affairs in which Isaac has not yet imparted a blessing, imparting the blessing on Esau and imparting it on Jacob are contingent states of affairs. However, in the state of affairs in which Isaac has already imparted the blessing on Jacob, imparting it on Esau is an impossible state of affairs and imparting it on Jacob is a necessary one.

The problem of the present is worth attention here. In the context of the antinomy of future contingents, present states of affairs are usually treated in the same way as the past ones. Because of that, (1) is usually understood as implying that every past or present state of affairs is determined – or, more

precisely, with reference to a state of affairs x every state of affairs earlier than x and every state of affairs simultaneous with x is determined. This is because we treat the present, just like the past, as closed or already effected. In spite of that, it should be clear that the considerations presented here retain their validity independently of whether such an assumption concerning the present states of affairs is in force. Additional distinctions associated with the physical meaning of time and relativistic physics can be passed over as irrelevant to the discussion.

The assumption (3), apart from the notions already defined, feature the notion of the *representative* of a state of affairs. To put it generally, a representative of the state of affairs x is the state of affairs in which x is reflected. By *reflection* we should here understand a *copy*, in particular respects, of the original state of affairs. Thus, saying that a state of affairs y is a representative of a state of affairs x means claiming that *in particular respects*

$$\text{a state of affairs } y \text{ is similar to a state of affairs } x, \tag{6a}$$
$$\text{a state of affairs } y \text{ is an effect of astate of affairs } x. \tag{6b}$$

In the condition (6b), instead of saying that a state of affairs y is an effect of a state of affairs x, one could say that a state of affairs x is the cause of the similarity between states of affairs x and y. Not every state of affairs is fit to be a representative of other states of affairs, but only the one that possesses the ability to reflect described above. This ability is possessed by, among other things, propositions, judgments, and beliefs. What is more, it is propositions, judgments, and beliefs that are typical representatives, although they are not the only possible candidates for that role. The term "representative" usually indicates that both conditions (6) are fulfilled. Often it is enough to focus on the condition (6a). In that case one can use the term "equivalent", which expresses a symmetric relation: the original state of affairs and its representative are (in particular respects) equivalents of each other.

In the context of the problem of future contingents a representative has to be similar to the original in terms of modality. If a state of affairs x is a representative of a state of affairs y, then, for any state of affairs z, x is necessary, impossible or contingent with reference to the event z if and only if y is, respectively, necessary, impossible or contingent with reference to z. In other words, a state of affairs x agrees with a state of affairs y in terms of modal properties with reference to any state of affairs z. This condition can be fulfilled by many different states of affairs, which is why the problem of future contingents can have different versions.

THE FORMALIZATION OF THE ANTINOMY OF FUTURE CONTINGENTS

Assumptions (1), (2) and (3) can be formalized in a first-order language. The alphabet of that language contains the following constant logical symbols: negation "$\neg$", conjunction "$\wedge$", disjunction "$\vee$", conditional "$\rightarrow$", biconditional "$\equiv$", universal quantifier "$\forall$", and existential quantifier "$\exists$", as well as individual variables "x", "y", "z", etc. and the usual punctuation marks. Individual variables run over any universe of states of affairs. Two other specific constants, namely two-place predicates "P" and "C", belong to the alphabet too. The expression "$P(x,y)$" should be read: the state of affairs x is earlier than the state of affairs y; the expression "$C(x,y)$" should be read: the state of affairs x is contingent in relation to the state of affairs y. Two secondary terms, "S" and "E", whose function is to aid the formalization of the assumption (3), can be introduced by means of the definitions:

$$S(x,y) \equiv \forall z : ((P(x,z) \equiv P(y,z)) \wedge (P(z,x) \equiv P(z,y))),$$
$$E(x,y) \equiv \forall z : ((C(x,z) \equiv C(y,z)) \wedge (C(z,x) \equiv C(z,y))).$$

The following expressions, which are the formalizations of, respectively, assumptions (1), (2) and (3), constitute the axioms specific to the theory:

$$\forall x,y : (P(x,y) \rightarrow \neg C(x,y)), \tag{7}$$
$$\exists x,y : (P(x,y) \wedge C(y,x)), \tag{8}$$
$$\forall x,y : \exists z : (S(z,x) \wedge E(z,y)), \tag{9}$$

The axiom (7) means that, for any states of affairs x and y, if x is earlier than y, then x is not contingent with reference to y. The axiom (8) means that there exist two states of affairs x and y such as x is earlier than y and y is contingent with reference to x. The axiom (9) means that for any two states of affairs x and y there exists a state of affairs z simultaneous with x and similar to y in terms of modality. Of course, the axiom (9) concerns the relation of representing y by z in x. However, one can limit oneself to the aspect of similarity described in the condition (6a), passing over the aspect of asymmetry between the original state of affairs and its representative expressed in the condition (6b). Because of that, a broader notion of equivalent rather than a narrower notion of representative is formalized in the axiom (14). This does not influence formal results, but

makes the constructed theory much simpler and less exposed to errors, taking into consideration all the factors relevant for the antinomy of future contingents.

On the one hand, the theory defined by the three axioms (7), (8) and (9) is contradictory. In order to realize this, it is enough to assume, on the basis of the axiom (8), that $P(a,b)$ and $C(b,a)$, where letters "a" and "b" are individual names of events about which nothing else has been assumed and have been deduced on the basis of the Skolem reduction. On the basis of the axiom (14) one is allowed to assume that $S(d,a)$ and $E(d,b)$ and that $S(f,b)$ and $E(f,a)$), where again "d", "f" are individual names of events about which nothing else has been assumed and have been deduced on the basis of the Skolem reduction. That allows for the conclusion that $P(d,f)$ and $C(d,f)$. However, on the basis of the axiom (9) one is allowed to conclude that $\neg C(d,f)$, which results in a contradiction an exact proof can be found in Tkaczyk 2015, 173–4.

On the other hand, axioms (7) and (8), (9) do not contradict each other, and every one of them is independent of the other two. In order to realize it, one can make use of the three interpretations of the constructed language in well-known theories:

$$P(x,y) \equiv (x = y \vee x \neq y), \qquad C(x,y) \equiv (x = y \vee x \neq y), \tag{10}$$

$$P(x,y) \equiv (x = y \wedge x \neq y), \qquad C(x,y) \equiv (x = y \wedge x \neq y), \tag{11}$$

$$P(x,y) \equiv x < y, \qquad C(x,y) \equiv x > y. \tag{12}$$

As a result of adding definitions (10) to the first-order logic, the expression (7) turns out to be unprovable, while expressions (8) and (9) turn out to be provable in the first-order logic. From this it follows that expressions (8) and (9) make up a non-contradictory theory in which the expression (7) is not provable. As a result of adding definitions (11) to the first-order logic, the expression (8) turns out to be unprovable, while expressions (7) and (9) turn out to be provable in the first-order logic. From this it follows that expressions (7) and (9) make up a non-contradictory theory in which the expression (8) is not provable. As a result of adding definitions (12) to the arithmetics of natural numbers, the expression (9) turns out to be unprovable, while expressions (7) and (8) turn out to be provable in the arithmetics of natural numbers. From this it follows that expressions (7) and (8) make up a non-contradictory theory in which the

expression (9) is not provable an exact proof can be found in TKACZYK 2015, 171–4.

Since expressions (12), (13) and (14), define a contradictory theory on the one hand but, on the other hand, do not contradict each other, it is clear that the antinomy of future contingents is authentic and requires solution, but for the antinomy to arise all three assumptions — (1), (2), (3) — are required.

ARISTOTLE'S VERSION OF THE ANTINOMY

Since the assumption (3) can take different forms, the antinomy of future contingents occurs in different versions on the grounds of different theories, the latter being sometimes extremely distant from each other. The multiplicity of the forms of the assumption (3) stems from the multiple ways in which modal equivalents of states of affairs can be constructed.

The oldest version of the antinomy of future contingents is mentioned in the ninth chapter of Aristotle's *Hermeneutics* (ARISTOTLE 1949). Having asked a question whether the propositions "there will be a sea battle tomorrow" and "there will be no sea battle tomorrow," which describe future contingent state of affairs, are already true or false, Aristotle seriously considers giving a negative answer. If the first of the two propositions was true now, the tomorrow's sea battle would be a necessary state of affairs, and if it was now false, the tomorrow's sea battle would be a necessary state of affairs. In light of that, if the proposition in question was true or false now, the tomorrow's sea battle would be a determined state of affairs. However, it is in principle a future and contingent state of affairs. An analogical argument can be made concerning the second of the two propositions (cf. ŁUKASIEWICZ 1961b, 161–3; KNEALE 1962, 46–9).

In this version of the antinomy of future contingents, equivalents (representatives) of states of affairs are constructed by means of the notion of truth. The construction is based on the assumption that, for any proposition φ, φ is equivalent to the proposition stating that φ is true, with the proposition stating that φ was true yesterday, etc., and finally with the proposition that φ has eternally been true. Even if the proposition φ describes some future state of affairs, the proposition stating that φ is true describes a present state of affairs, and the proposition stating that φ was already true before describes a past state of affairs. These states of affairs occur at different times but have the same modal properties, which is why they are each other's modal equivalents.

The assumption — allowing for constructing the equivalents of events in the way described above — can assume the form of the principle of bivalence, which states that every proposition has exactly one of the two logical values: the value of truth or the value of falsity. Along with accepting the principle of bivalence, one should assume that the proposition φ, which describes any future state of affairs, is either true or false. In light of that, the proposition stating that φ is true is also, respectively, true or false. Since the proposition in question describes a past state of affairs, by virtue of assumption (1), this state of affairs is determined. This means that the proposition φ describes a determined state of affairs. Since the proposition φ has been chosen at random, every future state of affairs is determined, which contradicts assumption (2).

The assumption in question can also take the form of the principle of excluded middle, which states that out of any two propositions one of which is the negation of the other at least one proposition is true. Accepting the principle of excluded middle and having chosen the proposition φ, which describes any future state of affairs, one has to assume that either the proposition φ or its negation is true. If the proposition φ is true, the proposition which is its equivalent and which states that φ is true is also true. The latter proposition, in virtue of the assumption (1), describes a determined state of affairs, so the proposition φ also describes a determined state of affairs. If, however, the negation of the proposition φ is true, the proposition which is the equivalent of this negation and which states that the negation of φ is true is also true. The latter proposition, in virtue of the assumption (1), describes a determined state of affairs, which means that the negation of the proposition φ also describes a determined state of affairs. Since either the proposition φ or its negation describes a determined state of affairs, every future state of affairs is determined, because the proposition φ was chosen at random. This, however, contradicts the assumption (2).

DIODORUS' VERSION OF THE ANTINOMY

The leading logician of the Megarian school and a sharp polemicist against Aristotle and his students, Diodorus Cronus of Iasos, had a thorough understanding of the structure of the antinomy of future contingents. Diodorus is reported to have noticed that accepting the following three assumptions, i.e. theses, at the same time, leads to a contradiction:

every proposition about the past is necessary, (13)
some proposition is possible but is not and will not be true, (14)
a possible proposition is not followed by an impossible proposition, (15)

Since he was convinced that theses (13) and (15) are obviously true, he rejected thesis (14), overcoming — as he believed — Aristotle's theory of act and potency. Unfortunately, Diodorus' line of reasoning is known only from a tertiary source: it has been related by Arrian of Nicomedia in the work *Discourses of Epictetus* (EPIKTET 1916, vol. 2, ch. 19, par. 1).

Propositions (13) and (14) express relatively clear variants of, respectively, assumptions (1) and (2). Proposition (13) expresses assumption (1), referring to necessary propositions instead of necessary state of affairs. Analogically, proposition (14), referring to propositions, assumes the existence of a possible proposition describing a state of affairs which has not occurred and will never occur, which means that it is contingent. The way of constructing modal equivalents of states of affairs is here similar to the one from the Aristotle's version, but Diodorus refers directly only to propositions and not to states of affairs.

The literature is dominated by the following two ways of understanding proposition (15), which is a version of the assumption (3) but has been passed down by Epictetus or Arrian in an unclear, manifestly distorted form:

a possible proposition does not imply an impossible proposition, (15′)
a possible proposition does not become an impossible proposition later in time. (15″)

In version (15′), which appears in the *Discourses*, the expression "is followed by" is understood as a logical term referring to the relation of logical implication. Thus, proposition (15′) constitutes a principle known to Aristotle and derivable in regular modal logics: if the expression ψ is logically implied by the expression φ and φ is possible, then ψ is possible too (this is how Diodorus' reasoning is understood by, among other authors (BOCHEŃSKI 1956; MATES 1961; and KNEALE 1962). In version (15″) the expression "is followed by" has a temporal meaning and expresses change. According to thesis (15″), no state of affairs possible at some time can later become impossible (this is how Diodorus' reasoning is understood by, among other authors (ZELLER 1882; RESCHER 1966). In both interpretations proposition (20) is an expression of assumption (3) and provides a possibility of constructing equivalents of any state of affairs.

According to the record of Epictetus and Arrian, Diodorus Cronus, while polemicizing against Aristotle, agreed with him that theses (13), (14) and (15) make up a contradictory theory. Nonetheless, as opposed to Aristotle, Diodorus was inclined to reject thesis (19), referring to the open future.

In the 20th century Jan Łukasiewicz, consciously looking back towards the antiquity, initiated innovative research on the antinomy of future contingents. Taking the assumptions (1) and (2) to be unassailable, Łukasiewicz decided to reject assumption (3) in the form of the principle of bivalence (ŁUKASIEWICZ 1961a; ŁUKASIEWICZ 1961b).

ŁUKASIEWICZ'S VERSION OF THE ANTINOMY.

In one of the influential works of Jan Łukasiewicz (ŁUKASIEWICZ 1961b) the antinomy of future contingents has been formalized in the language of modal logic with one-place connectives of necessity "$\Box$" and possibility "$\Diamond$". For any expression φ in an object language the arrangement of signs $\ulcorner(\Box\varphi)\urcorner$ and the arrangement of signs $\ulcorner(\Diamond\varphi)\urcorner$ are also expressions of the object language and are to be read as, respectively: it is necessary that φ; it is possible that φ. With reference to modal connectives it is enough to accept the principle of extensionality and the common definition of possibility:

$$\Diamond\varphi \equiv \neg\Box\neg\varphi, \tag{16}$$

according to which the expression φ is possible if and only if the negation of φ is not necessary. In order to reconstruct the antinomy of future contingents, it is enough to consider the theory to which belong the following expressions:

$$\varphi \rightarrow \Box\varphi, \qquad \text{for every } \varphi, \tag{17}$$

$$\Diamond\varphi \wedge \Diamond\neg\varphi, \qquad \text{for some } \varphi. \tag{18}$$

Expression (17) constitutes a formalization of expression (1), while (18) is a formalization of assumption (2). According to assumption (17) every expression which is already true is also necessary. In light of that, every state of affairs which already occurred is necessary. According to assumption (18), at least one expression is possible itself and has a possible negation. In light of that, at least one state of affairs is contingent.

With reference to assumption (17) Łukasiewicz writes: "*Unumquodque, quando est, oportet esse*. «Whatever it is, when it exists, it is necessary.»

This statement originates in Aristotle, according to whom even if not everything that is is necessary and not everything that is not is impossible, when something that is exists, it is also necessary, and when something that is not does not exist, it is also impossible. (ŁUKASIEWICZ 1961b, 145). The reasoning is supported by examples: "Even though it is not necessary for me to be home this evening, still, assuming that I am home this evening, my being home this evening is necessary. Another example: even though it is rare for me not to have money in my pocket, still, assuming that I (at some moment t) do not have money in my pocket, it is not possible for me (at the same moment t) to have money in my pocket" (ŁUKASIEWICZ 1961b, 145). Łukasiewicz underlines that the conclusion about the necessity of the proposition is derived from the assumption that that proposition is true, and that the connective of implication "$\rightarrow$" is understood temporally (ŁUKASIEWICZ 1961b, 145–6]. Concerning assumption (23), Łukasiewicz writes: "According to Aristotle, some things are bilaterally possible, which means that they can but do not have to be. For example, it is possible that this dress will be cut, but it is also possible that it will not be cut. We say: it is possible for someone affected by illness to die, but it is also possible for him to regain his health, in which case he will not die" (ŁUKASIEWICZ 1961b, 146).

Having accepted assumptions (17) and (18), one can reconstruct the antinomy of future contingents almost immediately. On the ground of the standard logic, by means of the principle of extensionality and the definition (21), it is possible to trivially prove the equivalence of the expression (17) and the expression

$$\Diamond\varphi \rightarrow \varphi, \qquad \text{for every } \varphi. \tag{24}$$

What is more, out of expressions (23) and (24) it is easy to derive the conclusion

$$\varphi \wedge \neg\varphi, \qquad \text{for some } \varphi, \tag{25}$$

which determines that the theory defined by assumptions (17) and (18) is contradictory, since it contains both some non-specified expression φ and its negation.

Łukasiewicz's version of the antinomy of future contingents is very instructive. It may seem that it has been constructed solely on the basis of assumptions (1) and (2), without reference to the assumption (3). If true, that would negate the thesis that assumptions (1), (2) and (3) do not contradict

each other — but it only appears to be the case. Łukasiewicz makes use of the assumption (3) silently, accepting it in metalanguage. It is easy to notice that in the crucial step of the derivation some expression φ, whose existence is implied by the assumption (23), is substituted in the assumption (17). By the same token, the expression φ is itself its own equivalent in the sense of the assumption (3). In this case, the relation of identity is the relation of being equivalent. Such inference is feasible, because the assumption (17) contains a quantifier whose range is unlimited. Assuming that the expression $\ulcorner\varphi \rightarrow \Box\varphi\urcorner$ is a theorem for any φ, Łukasiewicz silently accepts that all expressions describe past states of affairs. In doing that, he manifestly commits the fallacy of circularity. To formalize the assumption (1) correctly, one would have to make an assumption weaker than the assumption (17) – namely, to assume that the expression

$$\varphi \rightarrow \Box\varphi, \text{for every } \varphi, \text{ which describes a past state of affairs,}$$

(or possibly: for every expression φ in the present or past tense, etc.) is a theorem. A quantifier with such a limited range does not include the expression whose existence is stated by the assumption (18), so contradictory expressions would not be derivable. To arrive at a contradiction, one would have to accept some version of the assumption (3) explicitly, e.g. to accept that for every expression φ there exists an expression φ', equivalent to φ and describing a past state of affairs.

PRIOR'S VERSION OF THE ANTINOMY

Arthur Norman Prior, who initially accepted Łukasiewicz's account (PRIOR 1953), finally came to believe that understanding and solving the antinomy of future contingents in a correct way requires introducing temporal connectives to formal logic (PRIOR 1967). Prior introduced to the alphabet of classical logic four one-place temporal connectives: "F", "P", "G" and "H". For any expression φ the inscriptions: $\ulcorner(F\varphi)\urcorner$,$\ulcorner(P\varphi)\urcorner$,$\ulcorner(G\varphi)\urcorner$ and $\ulcorner(H\varphi)\urcorner$ are also expressions and should be read as, respectively: at some point it will be the case that φ; at some point it was the case that φ; it will always be the case that φ; it was always the case that φ. In addition to that, sometimes the alphabet includes modal connectives.

In Prior's version the state of affairs which consists of the expression φ being true at the moment t is represented in the sense of conditions () at

moments different from t by states of affairs which consist of the expression $\ulcorner(F\varphi)\urcorner$ or the expression $\ulcorner(G\varphi)\urcorner$ being true at a moment earlier than t and of the expression $\ulcorner(P\varphi)\urcorner$ or expression $\ulcorner(H\varphi)\urcorner$ being true at a moment later than t.

It is possible to reconstruct the equivalent of assumption (3) in the language or metalanguage of temporal logic. The expression $F\varphi$ is true at a point t_1 if and only if φ is true at some point later than t_1 — let it be the point t_2. At any point t later than t_1 but earlier than t_2, the expression $\ulcorner F\varphi\urcorner$ in the future tense and the expression $\ulcorner HF\varphi\urcorner$ in the past tense is true. These two expressions are equivalents of each other in the sense of thesis (10). For instance, the future event which consists of there being a sea battle at some point in the future corresponds to the past event which consists of "There will be a sea battle at some point in the future" having always been true (Tkaczyk 2015, 298–99, 375–82).

THE THEOLOGICAL VERSION OF THE ANTINOMY.

In the first century BC Marcus Tullius Cicero, having noticed an analogy between a true proposition describing the future and the knowledge of the future, in his work *De fato* formulated the best-known version of the problem of future contingents. In this version of the antinomy assumption (3) takes the form of the thesis about the existence of an omniscient agent. For any event, the equivalent of this event is the knowledge of an omniscient agent, encompassing the event in question. Since the term "omniscience" does not have a clearly established meaning, not every way of understanding it results in an antinomy. For the antinomy to arise one has to assume that there exists at least one agent x and at least one event y such that y is contingent from the viewpoint of x and, at the same time, x knows whether y will occur. This sort of the knowledge about y can be called the foreknowledge about y. One can acknowledge that the omniscient agent — or some other agent — has unlimited foreknowledge, i.e. the knowledge encompassing all future events, that its foreknowledge is limited to some events, or that it is without the foreknowledge. For the antinomy of future contingents to arise, one has to acknowledge within the assumption (3) that there exists at least one agent which has the foreknowledge about at least one event.

Since the principle of bivalence lies at the basis of classical logic, the antinomy of future contingents with the assumption that propositions describing the future are true played an important role in the development of formal logic, especially in the creation of multi-valued and temporal logics. This version of the antinomy can legitimately be called semantic. The thesis that there exists a God who is, among other things, omniscient, belongs to the essence of theism (cf. SWINBURNE 2004, 7). Because of that, the antinomy of future contingents in connection to the assumption that there exists an omniscient being became one of the principal problems of metaphysics. This version of the antinomy can be called theological.

THE WAYS OF SOLVING THE ANTINOMY OF FUTURE CONTINGENTS

The majority of attempts to solve the antinomy of future contingents is concerned with assumption (3). In such attempts, assumptions (1) and (2) remain unchanged, while assumption (3) is modified, allowing one to hope for a non-contradictory theory. At first sight, perhaps, assumption (3) seems less obvious than the first two assumptions, since only (3) clearly exceeds common knowledge. Nonetheless, while considering modifications of (3) one should bear in mind two important reservations.

First, assumption (3) is in fact very weak, since it requires only that events can be represented in any way. (3) is a consequence of every one of the many different, much stronger assumptions, e.g. the principle of bivalence or the thesis that there exists an omniscient God. Because of that, contrary to appearances, solving the antinomy of future contingents by weakening (3) is not easy. In order to do that, one would have to undermine the basic framework expressed by thesis (3), which connects different versions of the antinomy — and most attempts at revising assumption (3) concentrate on the stronger theses mentioned above, out of which follows (3). In light of that, one has to take into account that solving the antinomy of future contingents by revising different versions of assumption (3) may be only apparent.

The second problem is that even if it was possible to succeed in replacing assumption (3) in some version of the antinomy of future contingents, it would not imply the possibility of extending that success to the remaining versions. For example, if could turn out that it is possible to construct an

acceptable theory of God who does not have foreknowledge, but the analogical weakening of the principle of bivalence would not be acceptable: the antinomy of future contingents would be solved not globally but only locally.

THE REVISION OF LOGIC

Jan Łukasiewicz believed in the possibility of solving the antinomy of future contingents by rejecting the principle of bivalence (ŁUKASIEWICZ 1961a; ŁUKASIEWICZ 1961b). This means rejecting thesis (3) in its semantic version, since the principle of bivalence allows for constructing equivalents of events at any time. For example, the event which consists of there being a sea battle at a moment t finds its equivalent in any moment t'. That equivalent is the event which consists of "a sea battle takes place at the moment t" being true at the moment t'. Łukasiewicz assumed that propositions describing future events are neither true nor false. On such assumption, he constructed multi-valued logics whose task was to replace classical propositional calculus and, by means of that, lay the antinomy of future contingents to rest.

Without making any assessments of the possibility of applying multi-valued logics in other fields in an efficient way, one is allowed to conclude that the attempt to solve the antinomy of future contingents in this way ended in a complete failure. Already in 1938 Ferdinand Gonseth has shown that Łukasiewicz's multi-valued logics cannot serve as a logic of propositions about future contingent events. On the one hand, the logics in question seem too weak, since they contain neither the law of non-contradiction nor the law of excluded middle, while even if the expression φ describes a future contingent event, the expression $\ulcorner(\varphi \wedge \neg\varphi)\urcorner$ describes an impossible event and the expression $\ulcorner(\varphi \vee \neg\varphi)\urcorner$ describes a necessary event. Because of that, expressions $\ulcorner\neg(\varphi \wedge \neg\varphi)\urcorner$ and $\ulcorner(\varphi \vee \neg\varphi)\urcorner$ should retain the status of tautologies – even on the assumption that expressions describing future contingent events are neither true nor false. On the other hand, the logics of Łukasiewicz seem too strong, being based on the assumption that the implication whose antecedent and consequent describe future contingent events is itself a true expression. Thanks to this assumption, Łukasiewicz's logics can preserve the law of identity. The expression $\ulcorner(\varphi \rightarrow \varphi)\urcorner$ indeed describes a necessary event, even if the expression φ describes a future contingent event. Nonetheless, in a general case the impli-

cation $\ulcorner(\varphi \to \psi)\urcorner$ of expressions φ and ψ describing future contingent events can itself describe a future contingent event. Such implication can become false when φ becomes true and ψ becomes false, and it can become true when φ becomes false or ψ becomes true. Because of that, if the antecedent and the consequent of that implication are neither true nor false, the implication itself should be neither true nor false too. Gonseth's argumentation was developed by other authors, supporting the belief that rejecting the classical propositional calculus does not give a chance of solving the antinomy of future contingents (Tkaczyk 2015, 235–78).

What is more, it has been shown in many ways that even replacing the principle of bivalence with other assumptions, on which the values of truth and falsity are reserved for expressions describing determined events, results in the classical propositional calculus, which should be accepted as binding also with reference to future contingent events. Thus, it should be acknowledged that the antinomy of future contingents does not stem from classical logic and rejecting that logic does not give a chance of providing an efficient solution of that antinomy – even locally (Tkaczyk 2015, 270–78, 327–58].

As opposed to Łukasiewicz, Arthur Norman Prior tried to solve the antinomy of future contingents by enriching classical logic with terms expressing temporal relations. Prior took temporal connectives to be indispensable in logic in the sense that he believed the lack of such connectives in the object language to be the source of an antinomy. Even though the equivalents of all theorems of the system of classical logic are theorems of temporal logic, these two logics, according to Prior, are alternative and competitory to each other.

These attempts end up in failure too, since in temporal logics either it is possible to reconstruct some version of the antinomy of future contingents or it is not possible to reconstruct the equivalents of assumptions (1)–(3). In the linear model of time, i.e. on the assumption that time consists of moments arranged linearly and that the expression $\ulcorner H\varphi\urcorner$ in the past tense is equivalent to the expression $\ulcorner\Box H\varphi\urcorner$ for any φ, it can be shown that the expression $\ulcorner F\varphi\urcorner$ in the future tense is equivalent to the expression $\ulcorner\Box F\varphi\urcorner$. This, however, is contrary to assumption (2) about the open future (Tkaczyk 2015, 297–99]. In order to avoid this difficulty, Prior employed the right-branching model of time, i.e. the model in which time branches towards the future. In such a model, at any moment t, for any moments t' and t'' earlier than t, moments t' and t'' are arranged linearly, i.e. either they are

equal or one of them is earlier than the other. At the same time, it can be the case that there exist such moments t, t' and t'' that the moment t is earlier than any of the two moments t' and t'' but neither t' is earlier than t'' nor t'' is earlier than t', nor t' and t'' are equal. In such a case, t' and t'' correspond to different possible variants of the future, i.e. to different states of affairs which are future and contingent with reference to the state of affairs at the moment t. Unfortunately, different ways of defining temporal and modal connectives in such models always lead to one of the two results: either it is possible to reconstruct the antinomy of future contingents in the way analogical to the linear model of time or the object language is so drastically impoverished that the thesis (3) turns out to be false. In the latter case the falsity of (3) consists, among other things, of the impossibility of describing present states of affairs representing future contingent state of affairs in the object language. Even though there exist symbols corresponding to the expressions "it will necessarily be the case that" and "it will possibly be the case that", no symbol corresponds to the expression of "it will be the case that". Such a language is not fit for normal use (Tkaczyk 2015, 306–26, 375–82). From that one is allowed to conclude that including in classical logic the notions associated with time does not lead to solving the antinomy of future contingents (Tkaczyk 2015, 279–326, 375–82].

Thus, one hundred years of attempts to solve the antinomy of future contingents by revising logic ends up in a blind alley. It is not logic that is the source of the antinomy of future contingents — the antinomy does not stem from the defective construction of language.

DIVINE OMNISCIENCE IN METAPHYSICS

It is possible to solve the antinomy of future contingents locally, in its theological version, if one accepts that God does not have foreknowledge — or, more precisely, by acknowledging that the agent having such knowledge does not exist. It is an authentic solution of the problem of future contingent events, but, since it concerns only the theological version of the problem, it is only a local solution. The value of this solution depends on one's readiness to accept — on the grounds of metaphysics or theology — a theory in which God does not have complete knowledge of the future (or possibly a theory in which God does not exist at all).

It seems that such a solution can in principle be accepted on the grounds of pure metaphysics, unconnected to any religion. Within metaphysics one should ascribe to God such and only such knowledge as is required by the functions fulfilled by God in a particular theory. For example, the God of Aristotle, who is the first unmovable mover possessing the characteristics of a final cause, does not have to possess knowledge about the changing world at all. On the other hand, the God of Plato, who creates the world on the pattern of eternal forms, has to possess comprehensive knowledge, but even he can probably do without foreknowledge. In metaphysics, God needs the knowledge about the world insofar as he is considered the creator of the world, providence, or a just judge — and possibly in similar theories. In such cases it has to be assumed that God has at his disposal some essentially privileged knowledge — maybe even some qualified form of omniscience. However, the knowledge in question usually does not have to be completely unlimited, and in particular it does not have to encompass universal foreknowledge. Already Marcus Tullius Cicero developed an interesting metaphysics, assuming that God does not have knowledge of future contingent events. This sort of a limitation of the divine omniscience was also accepted by Alexander of Aphrodisia, Celsus and some others (Tkaczyk 2015, 86). In contemporary times Richard Swinburne, among other authors, proposed a qualification of the divine omniscience analogical to the known qualifications of omnipotence; notably, Swinburne ascribes to God maximal knowledge which does not lead to an antinomy (Swinburne 2004, 94–5). A well-developed concept of God possessing comprehensive, privileged knowledge but devoid of foreknowledge is provided by open theism [a complete account of open theism can be found in the work of Dariusz Łukasiewicz (2014). It is undoubtedly possible to construct a metaphysical theory which deserves the name of theism but does not ascribe foreknowledge to God. In such a theory the antinomy of future contingents does not arise.

The matter becomes more complex if it is not possible to refrain from ascribing to God the knowledge of future contingent events. This can be the case within particular religions. For example, within Islam it is possible to make use of a concept of God who possesses foreknowledge as well as of the concept of God who does not possess it. Thus, a Muslim theologian has in this matter almost the same freedom as a metaphysician working outside of the religious context. Nonetheless, within Judaism and Christianity—and within the Biblical thought in general—one cannot in any way avoid ascribing to God unlimited and unqualified knowledge; in particular, it is not possible to avoid

ascribing to him universal foreknowledge [a detailed and source-based justification of these theses can be found in TKACZYK 2015, 89-222.

DIVINE OMNISCIENCE IN JUDAISM AND CHRISTIANITY

The Bible does not allow conceiving God as devoid of foreknowledge for two reasons. First, the holy text not only clearly, consistently and repeatedly ascribes to God foreknowledge, but also makes it the characteristic feature of the true God. According to the Bible, the one true God can be distinguished from idols on the basis of him — and only him — possessing unlimited knowledge of the future. The deities which do not possess foreknowledge do not in fact exist, being only creations of human imagination. This criterion of the existence of God is presented in the text of Deutero Isaiah — the oldest text known to history which is clearly and undoubtedly monotheistic (TKACZYK 2015, 93–5]. Second and more important, the Bible is replete with prophetic texts foretelling the future. One could venture saying that adumbrations of future events and their fulfillment constitute the core of the Bible's content. Subtracting the knowledge of future events from the Biblical notion of God would mean undoing the Bible itself.

Foreknowledge constitutes an integral divine attribute also in Jewish theology. This is the stance of the leading theological authorities of Biblical Judaism from before the fall of the Temple in Jerusalem (Philo of Alexandria) as well as of Rabbinic Judaism (Akiva ben Yosef and all, without exception, authors of the *Talmud*, Moses Maimonides). Philo, Akiva, the whole *Talmud* and Maimonides do not only univocally ascribe to God foreknowledge but also express the conviction that it is important for the Judaic concept of God and thus constitutes an integral element of the Judaic orthodoxy (TKACZYK 2015, 99–116). Tamar Rudavsky claims that up until the end of the Middle Ages only two philosophers of Judaism expressed some doubts about divine foreknowledge: Abraham ibn Daud (d. 180) and Levi ben Gershon (d. 1344). Both of them had a loose attitude to religion and theological tradition. Because of that, when facing the antinomy of future contingents, they decided to follow Pagan philosophy and reject foreknowledge. By making this decision they were consciously deviating from the univocal and binding tradition, thus confirming in an indirect way that divine foreknowledge belongs to the Judaic orthodoxy (RUDAVSKY 2010, 111–12).

Christian theology is equally firm when it comes to divine foreknowledge. Among the Church Fathers, theologians of the rank of Irenaeus of Lyon, Clemens of Alexandria, Origen, Tertullian, Gregory of Nyssa, John Chrysostom, Jerome of Stridon, Augustine of Hippo, Leo the Great and John of Damascus made statements about this matter. All of them accept the thesis that God has unlimited foreknowledge and believe it to be an essential element of Christian orthodoxy. As far as we know, it has not been called into question even once in the whole patristic literature. Apart from the arguments which have already been mentioned, Church Fathers adduced the necessity of foreknowledge for God's governing the world by means of his infallible providence, required in Christian theology, and some other, lesser arguments (LERCHER 1940, 68; HERVÉ 1949, 56–7; SCHMAUS 1960, 591, 595–6).

In the 9th century, as a result of a doctrinal dispute whose participants were Gottschalk of Saxony, Hincmar of Reims and John Scotus Eriugena, the doctrine of divine foreknowledge has been dogmatized a couple of times. The doctrine in question has been acknowledged to be a dogma of faith by the synods in Valence III (855), Savonnières (859) and Toul (860). According to the rulings of these synods, God possesses, and has possessed throughout the whole eternity, the knowledge of all, good and bad, actions of men: "[…] præscire et præscisse æternaliter et bona, qeæ boni erant facturi, et mala, quæ mali sunt gesturi" (DENZINGER 1991, No. 626).

In the 15th century, already after the Great Schism, a fierce dispute about divine foreknowledge, with Peter de Rivo and Henry of Zomeren as contending sides, took place at the University of Louvain. The dispute ended with the intervention of Pope Sixtus IV, who confirmed that the doctrine of divine foreknowledge is a dogma, referring to the theses contrary to it as disgraceful and deviating from the path of the Catholic faith: "scandalosæ et a catholicæ fidei semita deviæ" (DENZINGER 1991, No. 1396). Even though doctrinal declarations from the 9th century are decisive, the significance of the Lovanian dispute has been improved by its publicity (DENZINGER 1991, No. 1391-1396; TKACZYK 2015, 124–9).

In the Catholic Church the doctrine of divine foreknowledge has been solemnly confirmed at the First Vatican Council, in the dogmatic constitution *Dei Filius* from April 24, 1870. The thesis about God's foreknowledge appears in it in the context of providence and clearly encompasses also the future acts of human free will: "omnia enim nuda et aperta sunt oculis ejus, ea etiam quæ libera creaturarum actione futura sunt" (DENZINGER 1991, No. 3003).

It is worth noting that the doctrine in question was not a matter of controversy between the main currents of Christianity even at times of violent upheavals. The thesis that God possesses foreknowledge was treated as obvious by the main hierarchs of both the East and the West throughout the whole first millennium of the Church. This is testified by the presence of this claim in a preserved doctrinal letter from 1053 sent by Pope Leo IX to the newly elected patriarch of Antiochia, Peter III. The letter contains the claim that God had known both good and bad deeds of men even before they happened: "[…] præscivisse autem bona malaque" (DENZINGER 1991, No. 685). This is important, since the letters of this sort had a diplomatic character, constituting an answer to the request for confirming the election of the patriarch by the pope. Because of that, the content of such letters showed the unity of the hierarchs. Inserting the thesis about divine foreknowledge into a document of this type is a testimony that the thesis was obvious both for the author of the letter and for its addressee and in their respective environments. The significance of the quoted text is improved by the fact that the letter was written in the last year before the Great Schism, when the tension between Rome and Constantinople was already quite high. Apparently, the question of divine foreknowledge was not a matter of any tension. The Reformation, which in the 16th century initiated the period of extremely vehement doctrinal disputes and splits in the Christian world, did not in any way problematize the thesis about divine foreknowledge (HODGE 1871-1873). Significant currents of Christian thought considered God's universal foreknowledge to be certain, and the binding and dogmatic character of this thesis was perceived by practically all classic Christian authors as obvious.

DIVINE OMNISCIENCE IN ISLAM

The doctrinal situation is completely different in Islam. The Islamic theological tradition knows both prominent accounts ascribing foreknowledge to God and the ones which deny that he has it. At the same time, one has to remember that in Islam the notion of perfect being is connected to unlimited freedom rather than to immutability. Because of that, God's acquiring knowledge in time does not have to be perceived by Muslim theologians as an imperfection (TKACZYK 2015, 143–59).

Even though the Quran and the whole Islamic tradition ascribe omniscience to God many times, the omniscience in question can be interpreted in

different ways. In particular it is possible to interpret it so that it does not encompass foreknowledge of future contingent events. What is more, the Quran does not contain prophecies (some commentators point out one or at the most a few prophecies, which do not belong to the essential message anyway). Neither the credibility of God nor that of the holy text are here connected in any way to the knowledge of future contingent events. In addition to that, the Quran contains *the principle of abrogation* (2:106), which allows cancelling an earlier revealed thesis by a later one if it is called for by the circumstances (TKACZYK 2015, 135–43, 154).

No wonder that Muslim theologians have enjoyed significant freedom in this matter from the beginning. Different views on divine foreknowledge, including the ones denying its existence, were represented already in the oldest theological schools: those of the Jabarites and the Cadarites, later the Mu'tazilites and the Asharites as well as the Rafidites etc.

A clear statement that "God does not know any thing before it exists" can already be found in an early theological tract *Al-Ibanah*, and the texts from the circle of the Shabibiyyah state that "God's knowledge does not exist before that which people do, nor before that which they become". In another preserved text, originating in the school of the Rafidites, one can read that "God knows what will happen before it is, except the acts of men, since the latter he knows only in the state of their existence." A Rafidite known by name, Hisham ibn Hakam rejects foreknowledge, justifying his view by referring to the antinomy of future contingents: "if God possessed foreknowledge about what people will do, there would be no test (*al-mihnah*) and no free choice (*al-ihtiyar*)." In another place ibn Hakam writes that "it is not possible to be a possessor of knowledge in the proper sense of the word, if the object of that knowledge does not exist yet" (WOLFSON 1976, 661). We are also informed that the Shiite theologians from al-Kufah did not acknowledge divine foreknowledge at all. There, the standard teaching was that God "acts through change", which means: reacts to events at the time when they occur. It was maintained that God "does not carry in him" his knowledge or his will, which were considered mutable. There even are parables in which God intervenes to rectify something he did not predict earlier. As we can see, God was not conceived as immutable. At the same time, mutability was not treated as an ontological defect, because the Shiites of al-Kufah, as opposed to Parmenides and the metaphysical tradition initiated by him, associated the perfection of the divine being with unlimited freedom rather than immutability. This allowed them to avoid not only the antinomy of

future contingent events but also many other problems of theodicy (Ess 1997, 439–40).

In other Muslim circles qualifying divine omniscience was often justified by means of original ontologies of modality, known as the theories of the *impossibles*. The classic authors of such theories include Ikhwan al-Safa, ibn Hazm and Al-Ghazali. Within the theories of the impossibles, impossible events were divided according to the source of impossibility — for example, they could be absolutely impossible, impossible by nature, impossible in virtue of the constitution of human reason, etc. Some Muslim theologians taught that God's having foreknowledge is impossible because of the decision of God himself. While giving humans free will, God decided to limit not only his omnipotence but also his omniscience. Within such a framework, divine foreknowledge would be impossible because of God's will and incomprehensible wisdom (Wolfson 1976, 580, 662).

Islamic theology knew the whole spectrum of views concerning divine foreknowledge already during the classical period of its development. Apart from the views harmonizing with Judaism and Christianity, stating that God knows all future events, Muslim theologians held accounts which did not ascribe such knowledge to God. The source of this difference in theological approach lies probably in the differences between the sacred texts which have been described above.

It seems that one can deny divine foreknowledge and remain within the bounds of Islam, just like it is the case with theistic metaphysics unconnected to religion. Such an option, however, is out of the question in the cases of Judaism and Christianity.

In light of that, limiting assumption (3) by rejecting foreknowledge can be considered a solution of the problem of future contingents only locally. This is because, first, important theological traditions such as Judaism and Christianity exclude the possibility of qualifying the omniscience of God in any way, even though they allow qualifying omnipotence to a certain degree. Second, even if one breaks off these traditions and does metaphysics completely independently of them or, for example, in connection to Islam, one solves the antinomy of future contingents only in its theological version. That does not make the antinomy disappear — especially in its semantic version. It is true that there have been attempts to solve the theological antinomy indirectly, by rejecting the principle of bivalence. For instance, in the Middle Ages Peter Auriol and Peter de Rivo reasoned that, since the propositions about future contingent events are neither true nor false and

omniscience consists of knowing all true propositions, rejecting the principle of bivalence automatically does away with foreknowledge (Tkaczyk 2015, 124–5). Nonetheless, even a possibly efficient solution to the theological version of the antinomy cannot easily be transferred to its semantic version.

CLOSED FUTURE

The manifold attempts to solve the antinomy of future contingents by revising the assumption (3) fail, since that premise is in fact very weak: it only requires any possibility of representing events by other events. In order to solve the antinomy of future contingents in an efficient way, it is not enough to reject the principle of bivalence, foreknowledge etc. One should rather exclude the option of referring to contingent events in any way — but that would mean the end of thought and speech. Because of that, one should look for the solution to the problem of future contingent events in premises (1) and (2) and not in premise (3).

Premise (2) states that the future is to a certain degree open in the sense that at least one future event is contingent. From the logical point of view this thesis is very weak, since it begins with an existential quantifier. Such a weak thesis is enough for the antinomy of future contingent events to arise. Because of that, premise (2) can basically be weakened in only one way: by a simple negation. One would have then to accept that all events are determined – in this respect the future would not differ from the past.

Negating premise (2) and acknowledging all events to be determined is a correct way to efficiently and globally solve the antinomy of future contingents. It is also a very simple move. Nonetheless, its cost in terms of world-view consequences may turn out to be too high.

Rejecting premise (2) means returning to the metaphysics of Parmenides, who claimed that "being is and necessarily is; not being is not and necessarily is not" (Reale 1987, 83). According to Parmenides, the only judgment that can be delivered concerning being states: "it is, or it is not. […] for powerful Necessity holds it in the bonds of limit, which constrains it round about" (as cited in Reale 1987, 85–6). In the world of Parmenides, every event which occurs is necessary and every event which does not occur is impossible. In such a case, modal distinctions collapse — expressions "is," "is possible" and "is necessary" become synonymous. This means accepting

radical determinism (fatalism), which encompasses not only the domain of physical events but all events. Even excluding mental attitudes from the scope of determinism, a move postulated by the Stoics, becomes impossible.

PARTIALLY OPENED PAST

Instead of rejecting thesis (2) and accepting radical universal determinism (fatalism), one can revise thesis (1). This also leads to solving the antinomy of future contingents correctly and globally.

Rejecting thesis (1), i.e. the thesis about the closed past, may seem too bold a move. Of course, simply rejecting the thesis about the closed past or accepting the thesis contrary to it is not an option, since thesis (1) claims that every past event is determined. (1) has very rarely been revised, but some attempts to do that have been known to history. The reason why they were so rare is that (1) appears to have a strong justification — one can even say that it seems obvious. Denying that past events are in principle determined would be only a little less absurd than accepting the contradiction resulting from the antinomy. Fortunately, thesis (1) begins with two universal quantifiers. Such a strong thesis is prone to being weakened, which can lead to solving the antinomy. Thus, it is not necessary to accept that no past event is determined, but only that some particular past events are contingent. Such thesis can be called the thesis about *the partially opened past* or the thesis about (some) past contingents.

It turns out that in order to solve all versions of the antinomy of future contingents it is enough to assume that events — even the present and the past ones — which represent contingent events are contingent themselves. Such an assumption makes it impossible to accept the thesis (1). One can, however, accept a weaker thesis instead:

Every past event which does not represent a contingent event is determined. (1′)

As we can see, (1′) does not constitute a simple denial of (1), but its weakening. Limiting the scope of the thesis about the closed past concerns only one group of events, namely, the events which represent some future state of affairs, being reflections of some future event.

Fortunately, weakening the premise (1) in this way solves the antinomy of future contingents. The theses (1′), (2) and (3) make up a non-contradic-

tory set. One can realize that by means of the expression in a first-order language described above:

$$\forall x, y : (\neg \exists z : (E(x, z) \wedge C(z, y)) \rightarrow (P(x, y) \rightarrow \neg C(x, y))). \tag{7'}$$

The set of expressions (7′), (8) and (9) is non-contradictory. In order to realize it, it is enough to notice that in the interpretation (15) all these three expressions are provable in first-order logic. From this it follows that the theory based on the axioms (7′), (8) and (9) is non-contradictory.

If replacing the thesis (1) with the thesis (1′) removes the antinomy of future contingents efficiently and globally, the only thing left to do is to check if such a solution is acceptable in terms of worldview consequences. This seems to cause a difficulty, since the (1) is considered obvious or even logically necessary. It seems, however, that the difficulty is only apparent, and (1') is actually better justified than (1).

A POSTERIORI CLOSED PAST

A classical justification of the thesis about the closed past can be found in Aristotle's *Nicomachean Ethics*. The justification given there is empirical. According to Aristotle, since an action is an effect of a decision and a decision is an effect of cognitive and attitudinal states, one cannot make decisions or act with reference to past state of affairs: "Nothing that is past is an object of rational choice; no one, for example, rationally chooses to have sacked Troy, because nobody deliberates about the past, but rather about the future and what can turn out in one way or another; and it is not possible for the past not to have happened. So Agathon was right to say: «Of this one thing is even god deprived, To make what has been done not to have happened»" (ARISTOTLE 1894, 105).

A contemporary version of this argument has been presented by, among other authors, Igor Novikov. Novikov enumerates three spheres of experience, universally accepted by the scholars, which indicate the irreversibility of the passage of time. Novikov's text is worth quoting extensively. "We have thus looked at three types of natural phenomena that are patently non-symmetric in time and evolve in a single direction, at least in today's Universe. The first class is the class of thermodynamic processes. They evolve so as to increase chaos and entropy. Such processes define the «thermodynamic arrow of time». The second phenomenon is the expansion

of our Universe; it gives the «cosmological arrow of time». The third class of phenomena includes our psychological processes that give a subjective feeling of the flow of time. Our memory of the past and ignorance of the future provide the «psychological arrow of time». The puzzling thing is the fact that all three «arrows» point in the same direction in our Universe of today." (NOVIKOV 2001, 254). What matters here is that crucial phenomena in the known world indicate the existence of an irreversible arrow of time, but what is even more important is that, as stressed by Novikov, all the arrows of time which can be reconstructed in this way coincide, pointing out in the same direction. As a result, the thesis about the anisotropy of time is strongly and comprehensively grounded in experience; one can even say that it is supported by the entirety of the latter. Thus, the thesis about the closed past becomes strongly embedded in experience through the thesis about the arrow of time.

At the same time, Léon Brillouin claims that it is not particular laws or theories but rather science and common experience as a whole that indicate that the past is completely and ultimately determined. Just like Novikov, among the particular claims of physics he points out first and foremost the second principle of thermodynamics, which means the thermodynamic arrow of time (BRILLOUIN 1971, 101–2, 110].

Additional justification is provided by the theory of relativity — especially the thesis that all physical signals travel with limited speed. As a result of the latter, it does not seem possible to send physical signals to past events. What is more, constructing in Minkowski's cone, which serves as the principal model of the special theory of relativity, past event is even defined by means of the physical signal. If it is possible to send a physical signal from the event a to the event b, a is acknowledged to be absolutely earlier than b (TKACZYK 2015, 385–7).

A PRIORI CLOSED PAST

The dominant view in the literature states that retroactive causal connections, and thus the opened past, are a priori impossible. The notion of an effect proceeding its cause in time is often treated as self-contradictory. Such a view stems from the writings of David Hume, who, trying to define cause and effect in purely observational terms, introduced the definition of causal connection as constant succession in time. The influence of Hume is so strong that his claim has been accepted on a very wide scale. Contem-

porary authors treating the existence of retroactive causal connections as self-contradictory and logically impossible include Anthony Flew, William Lane Craig, Michael Dummett, Richard Gale and Linda Trinkaus Zagzebski (DUMMETT & FLEW 1954; DUMMETT 1964; 1986; CRAIG 1991; GALE 1991; ZAGZEBSKI 1991).

It is hard to agree with this view, especially that no authentic arguments against the logical possibility of retroactive causal connections have been proposed. On the contrary, one can provide good reasons supporting such possibility.

First, it is not necessary for any relations or temporal properties to be included in the notion of cause. Defining causal connection in temporal terms is an arbitrary decision of Hume and his followers. Before Hume, philosophers had often accepted the possibility that a cause and its effect occur simultaneously or timelessly. According to Stefan Swieżawski, a popular traditional view stated that "a cause can be earlier than an effect, but the cause and its effect can also be simultaneous or transcend the temporal order" (SWIEŻAWSKI 1999, 320). This was connected, among other things, to the belief that God acts beyond time, and to the observation of one's own mental states, which can elicit immediate spiritual effects (SWIEŻAWSKI 1999, 319–20). Because of that, scholastics taught that the beginning in time is not included in the notion of cause: "in conceptu causalitatis non includitur initium in tempore" (SWIEŻAWSKI 1999, 320).

Second, though most philosophers have always rejected the possibility of retroactive causation, we know of some better or worse developed accounts which allow for such possibility. The accounts in question have been rejected quite universally, but they have not been criticized as self-contradictory (TKACZYK 2015, 365–75).

Third, even though in the field of science a cause always proceeds its effect in time, the history of science knows many cases in which retroactive causation has been assumed. Up until now, it has always turned out that alleged retroactive causation is apparent. It should be clear that within scientific theories it is possible to form a hypothesis which takes into consideration a retroactive cause and that such a hypothesis is tested just like all the other ones. This indicates that the temporal antecedence of a cause in relation to its effect has a strong grounding in experience, but not in logic itself a very good review and discussion of the cases of apparent retroactive causation in science can be found in the work of Craig (1991). Also Novikov, in the work which has already been mentioned, discusses models of

retroactive causation consistent with contemporary physical theories. One of such models is based on the theoretical possibility of sending physical signals to the past through two spatially close black holes in a bent space time resembling the sign "⊃". We are not concerned here with the technical possibility of apparent time travel and changing the past in the way described in the famous grandfather paradox, but only with the consistency with the known laws of physics (NOVIKOV 2001, 230–64).

Fourth and most important, it is possible to point out the examples of retroactive causes, and the existence of a model determines that contradiction is absent. Retroactive causes exist, but exist beyond the field of physics or science in general. They exist in the sphere of culture, which, as a creation of human minds, is not limited by the existing laws of nature.

The first example of a retroactive cause that inevitably comes to mind is retroactive legal norm, i.e. a norm which affects the acts done prior to its passing (the notion of a retroactive norm is discussed in detail in JURATOWITCH 1908, 5-8). As noted by Ben Juratowitch, striving to avoid retroactive norms was one of the greatest ambitions in the history of law (JURATOWITCH 1908, 27). However, even that indirectly indicates that a law operating retroactively not only is possible but also actually happens. On the other hand, William Crosskey shows that even at the moment when the Constitution of the United States was being shaped the views on this subject were divided, and the option of accepting some degree of retroactivity in law for socially important reasons had many proponents. The victory of the opponents of retroactive laws was brought on by the universal abuse of the possibility of enacting such laws in many states (CROSSKEY 1947, 539–41). Establishing a retroactive law takes place systematically in those legal systems where the rule of precedent is in force. Legal enactments made in such a context have retroactive binding force (JURATOWITCH 1908, 37–42). This is not about whether establishing retroactive norms is allowed or whether legal retroactive causation is laudable or not. What matters is that retroactive laws are possible and have been enacted in the past. If in 2018 some lawgiver established a law stating that from January 1, 2017, trucks are not allowed to enter the cities, he would elicit an effect earlier than its cause, since establishing the law in 2018 would constitute a cause whose effect would be the ban on trucks entering the cities in 2017. The ban on trucks is some state of affairs, even if not a physical one. Thus, in the cultural sphere it is possible to elicit the effect in the past, which means that retroactive causation is not self-contradictory or logically impossible.

Another example of retroactive causal connection in the cultural sphere is provided by historiography. Constructing such cultural beings as World War II, one can elicit in them effects from the future. For example, it is possible to decide in the 21st century when did World War II begin: we can decide that it began in 1936, 1938, 1939 or 1941. In this way the effect is elicited retroactively.

States of affairs which are the creations of performative utterances can serve as the third example. For instance, at the Catholic University of Lublin classes begin after the summer holidays on October 1, but the official opening of the academic year takes place on the third Sunday of October. Reciting the prescribed formula and thus opening the academic year, the rector acts retroactively, making the actions taking place since October 1 the matter of a cultural artefact called the academic year (TKACZYK 2015, 393–400).

One can say that the laws of logic themselves do not require any temporal relations between a cause and its effect. The thesis about the temporal antecedence of a cause in relation to its effect is binding in the sphere of physical events. Inside that sphere it is strongly justified, but its justification is empirical. In the sphere of physical events, everything thus far indicates that an effect necessarily follows its cause in time. As far as we know, it is not possible to send physical effects to the past. On the other hand, nothing indicates that a similar limitation is in force outside the sphere of physical events. On the contrary, we know about the cases of retroactive causal connections in the sphere of cultural artefacts. Thus, we know about the cases of non-physical retroactivity. The language comes into being to a large degree in contact with objects falling under the senses, which is why a retroactive causal connection can be difficult to imagine. A similar difficulty accompanies the attempts to imagine quantum effects, which, however, does not make quantum mechanics contradictory. Thus, retroactive causal connections can be difficult or even impossible to imagine, but nothing so far should dispose us to think that they are illogical. If this is the case, nothing stands in the way of employing the notion of retroactive cause to solve the antinomy of future contingents.

FUTURE VS. PAST CONTINGENTS

Having acknowledged that every event that is a representative of a contingent event in the sense of conditions (6) is contingent itself, one can solve the antinomy of future contingents in all its versions.

With reference to the semantic version initiated by Aristotle, one can say that the principle of bivalence and related principles are binding also for the propositions about future contingent events. Let the proposition φ describe a future contingent event y. The proposition stating that φ has always been true describes the event y, which is a representative of x in the sense of conditions (6). y is contingent as long as x is contingent, even if y is past. This is how weakening the thesis (1) to the thesis (1′) works.

Thus, one should state that the propositions describing future contingent events and those describing the events representing future contingent events are already true or false as a result of those future contingent events. This means that those propositions already have a logical value, but that value, though already present, will be imparted on them in the future.

It is retroactive causation in the sphere of cultural artefacts and not in the sphere of physical events that comes into play here. Language, including logical values, is partially a creation of the human mind. Because of that, nothing prevents every occurring state of affairs from *resulting* in imparting logical values on all the propositions which describe that state of affairs in the future, in the presence and in the past, by virtue of an implicit agreement between the language's users. A state of affairs consisting of any proposition φ being true or of it being false would be necessary, contingent or impossible no matter whether it was a past, present or future state of affairs, but only depending on whether the state of affairs described by φ is necessary, contingent or determined. In this way all the semantic versions of the antinomy of future contingents would be solved.

Analogically, with reference to the theological version of the antinomy, it can be said that God can possess foreknowledge insofar as the latter is an effect of future contingent events; speaking more generally, a agent x can possess the foreknowledge about a particular range of states of affairs if and only if x can efficiently act retroactively (elicit effects in the past) in this range. Thus, one can ascribe foreknowledge to God without a contradiction if and only if one also concedes him the ability to elicit effects in the past. It is worth adding that God does not have to make broad use of this ability. It is enough for him to retroactively elicit his knowledge in the sense that eternally possessed knowledge is a retroactive effect of future events. At the same time, God who possesses foreknowledge in principle has to possess the ability to act retroactively. Such a theory is non-contradictory even if its model is difficult to imagine (more difficult than that of other divine properties).

Limiting the thesis of the closed past in the way described here seems to be an efficient global way of solving the antinomy of future contingents. It also seems to be the best way. Retroactive causal connections, just like quantum effects, can be difficult to imagine, but there is nothing irrational about them.

Translated by Sylwia Wilczewska

REFERENCES

ARISTOTLE. 1949. "Liber de interpretatione". In *Aristotelis Categoriae et Liber de interpretatione*, edited by Lorenzo Minio-Paluello. Oxford: Clarendon Press.

ARISTOTLE. 2000. *Nicomachean Ethics*, edited by Roger Crisp. Cambridge: Cambridge University Press.

BOCHEŃSKI, Józef Maria. 1956. *Formale Logik*. Freiburg, München: Verlag Karl Alber.

BRILLOUIN, Léon. 1971. "The Arrow of Time." In *Time in Science and Philosophy*, edited by Jiři Zeman. Prague: Academia.

CRAIG, William Lane. 1991. *Divine Foreknowledge and Human Freedom. The Coherence of Theism. Omniscience*. Leiden, New York, København, Köln: E.J. Brill.

CROSSKEY, William W. 1947. "True Meaning of the Constitutional Prohibition of Ex-Post-Facto Laws." *The University of Chicago Law Review* 14, no. 4: 539–566.

DENZINGER, Heinrich. 1991. *Enchiridion symbolorum, definitionum et declarationum de rebus fidei et morum*, edited by Peter Hünermann. Freiburg im Breisgau: Herder.

DUMMETT, Michael. 1964. "Bringing about the Past." *Philosophical Review* 73, no. 3: 338–59. OI: 10.2307/2183661.

DUMMETT, Michael. 1986. "Causal Loops." In *The Nature of Time*, edited by Raymond Flood & Michael Lockwood. Oxford: Blackwell.

DUMMETT, [Michael] A[nthony] E[ardley], & A[nthony] FLEW. 1954. "Can an Effect Precede its Cause?". In *Belief and Will*. London: Harrison & Sons.

EPIKTET. 1916. *Dissertationes ab Arriano digestae*, edited by Henricus Schenkl, Lipsiae: Teubner.

ESS, Josef van. 1997. *Theologie und Gesellschaft im 2 und 3 Jahrhundert Hidschra: Eine Geschichte des religiösen Denkens im frühen Islam*. Vol. 1-6. Berlin & New York: Walter de Gruyter & Co.

GALE, Richard. 1991. *On the Existence and Nature of God*. Cambridge: Cambridge University Press.

HODGE, Charles. 1971-1873. *Systematic Theology*. Vol. 1-3. New York: C. Scribner & Co.

HERVÉ, Jean-Marie. 1949. *Manuale theologiae dogmaticae*. Vol. 2. Parisiis: Berche et Pagis.

JURATOWITCH, Ben. 2008. *Retroactivity and the Common Law*. Oxford: Hart Publishing.

KNEALE, William, & Martha KNEALE. 1962. *The Development of Logic*. Oxford: Clarendon.

LERCHER, Ludwig. 1940. *Institutiones theologiae dogmaticae*. Vol. 2. Œniponte & Lipsiæ: F. Rauch.

ŁUKASIEWICZ, Dariusz. 2014. *Opatrzność Boża, wolność, przypadek*. Kraków, Poznań: W drodze.

ŁUKASIEWICZ, Jan. 1961a. "O determinizmie." In Jan ŁUKASIEWICZ. *Z zagadnień logiki i filozofii*, edited by Jerzy Słupecki, 114–26. Warszawa: PWN.

ŁUKASIEWICZ, Jan. 1961b. "Uwagi filozoficzne o wielowartościowych systemach rachunku zdań." In Jan ŁUKASIEWICZ. *Z zagadnień logiki i filozofii*, edited by Jerzy Słupecki, 144–63. Warszawa: PWN.

MATES, Benson. 1961. *Stoic Logic*. Los Angeles: University of California Press.

NOVIKOV, Igor D. 2001. *The River of Time*. Cambridge: Cambridge University Press.

PRIOR, Arthur N. 1953. "Three-Valued Logic and Future Contingents." *The Philosophical Quarterly* 3, No. 13 (Oct., 1953): 317–26. DOI: 10.2307/2217099.

PRIOR. Arthur N. 1967. *Past, Present, and Future*. Oxford: Clarendon Press.

REALE, Giovanni. 1987. *A History of Ancient Philosophy*. Vol. 1: *From the Origins to Socrates*, edited John R. Catan. Albany, N.Y.: State University of New York Press.

RESCHER, Nicholas. 1966. "A Version of the Master Argument of Diodorus." *The Journal of Philosophy* 63, no. 15 (Aug. 11, 1966): 438–45. DOI: 10.2307/2024064.

RUDAVSKY, Tamar. 2010. "The Jewish Contribution to Medieval Philosophical Theology." In *A Companion to Philosophy of Religion*, edited by Philip L. Quinn & Charles Taliaferro, 106-13. Malden, Oxford, Chichester: Wiley-Blackwell.

SCHMAUS, Michael. 1960. *Katholische Dogmatik*. Vol. 1. München: Hueber.

SWIEŻAWSKI, Stefan. 1999. *Byt. Zagadnienia netafizyki tomistycznej*. Kraków: Znak.

SWINBURNE, Richard. 2004. *The Existence of God*. Oxford: Clarendon Press.

TKACZYK, Marcin. 2015. *Futura contingentia*. Lublin: Wydawnictwo KUL.

WOLFSON H. A. 1976. *The Philosophy of Kalam*. Cambridge, MA, London: Harvard University Press.

ZAGZEBSKI, Linda Trinkaus. 1991. *The Dilemma of Freedom and Foreknowledge*. New York: Clarendon Press.

ZELLER Eduard. 1882. "Über den kurieuon des Megarikers Diodorus." In *Sitzungsberichte der Königlichen Akademie der Wissenschaften*. Berlin.

THE ANTINOMY OF FUTURE CONTINGENT EVENTS

Summary

The antinomy of future contingents is here understood as a trilemma whose horns are (a) the thesis of the closed past, (b) the thesis of the open future, and (c) the thesis that all events can be represented at any time. The latter thesis can take different forms, like the principle of bivalence or the thesis of divine foreknowledge. Different versions of (c) lead to different versions of the antinomy itself. The antinomy has been formalized. It hasbeen proven that the theses (a), (b), and (c) make up an inconsistent set but are consistent with each other. Possible solutions have been considered. It has been argued that there are only two global solutions to the antinomy: radical determinism (fatalism) and retroactive causality. The latter solution has been recommended and developed.

ANTYNOMIA PRZYSZŁYCH ZDARZEŃ PRZYGODNYCH

Streszczenie

Antynomia przyszłych zdarzeń przygodnych jest tutaj pojmowana jako trylemat i składa się z (a) tezy o zamkniętej przeszłości, (b) tezy o otwartej przyszłości oraz przyjmującej różną postać (c) tezy o możliwości reprezentowania wszystkich zdarzeń w dowolnym czasie. Ta ostatnia teza może przyjąć postać zasady dwuwartościowości, tezy o wiedzy uprzedniej Boga lub inną postać. Różne wersje trzeciej tezy wyznaczają różne wersje antynomii przyszłych zdarzeń przygodnych. Antynomia została sformalizowana. Wykazano, że tezy (a), (b) oraz (c) tworzą zbiór sprzeczny, ale parami są niesprzeczne. Przedyskutowano możliwe rozwiązania antynomii. Pokazano, że są tylko dwa globalne rozwiązania: skrajny determinizm (fatalizm) oraz akceptacja retroaktywnych związków przyczynowych. To drugie rozwiązanie zostało zarekomendowane i opracowane.

Key words: time; cause; contingent; sea-battle tomorrow; foreknowledge; future contingents.
Słowa kluczowe: czas; przyczyna; przygodny; jutrzejsza bitwa morska; wiedza uprzednia; przyszłe zdarzenia przygodne.

Information about Author: Prof. Dr. hab. MARCIN TKACZYK— Department of Logic, Faculty of Philosophy, John Paul II Catholic University of Lublin; address for correspondence: Al. Racławickie 14, 20-950 Lublin; e-mail: tkaczyk@kul.pl. ORCID: https://orcid.org/0000-0003-0380-7072.

The preparation of the English version of *Roczniki Filozoficzne* (*Annals of Philosophy*) and its publication in electronic databases was financed under contract no. 753/P-DUN/2017 from the resources of the Minister of Science and Higher Education for the popularization of science.