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The Philosophy of Logic of Francisco Miró Quesada Cantuarias

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Abstract

In this historical article, Newton da Costa discusses Francisco Miró Quesada's philosophical ideas about logic. He discusses the topics of reason, logic, and action in Miró Quesada's work, and in the final section he offers his critical view. In particular, he disagrees with Miró Quesada's stance on the historicity of reason, for whom "reason is essentially absolute", whereas for da Costa it "is being constructed in the course of history". Da Costa concludes by emphasizing the importance of Miró Quesada's theory of logic and reason, despite it still being incomplete.

Keywords: Latin-American logic, history of logic, theory of reason, rationality, a priori knowledge, historicity of reason, history of paraconsistency.

Introduction by the Annotators

This is a historical article where Newton da Costa enters into a dialogue with Francisco Miró Quesada Cantuarias, one of his most important interlocutors in the field of logical-philosophical ideas. Da Costa presents and discusses our author's philosophical ideas about logic based mainly on four works [16–18, 20].

The original manuscript was written in Portuguese in 1988 on the occasion of 'Paco' Miró Quesada's seventieth birthday, when da Costa was a professor at the University of São Paulo (USP), Brazil. It was first published in a Spanish translation [7] supervised by Paco and made by his grandson, Francisco Miró Quesada Westphalen, for a collection edited by D. Sobrevilla and D. García Belaunde precisely in honor of his seventieth birthday [29]. The original was subsequently published in Portuguese in the now discontinued *Revista Brasileira de Filosofia* [8] without any important alteration in content.

The Spanish version differs from the original mainly with regard to a 'correction' that, according toda Costa (personal communication), Paco himself suggested with respect to the Portuguese original, and which we consider relevant for understanding the 'philosophical spirit' that guides his thought. In the original, da Costa refers to Miró Quesada as someone "whose God is Reason", a reference that in the Spanish version is consistently replaced by the characterization of Paco as someone who is "in love with reason" (lowercasing 'reason'). These substitutions reveal, in our view, a Platonic conception of philosophical knowledge as the intellectual ascesis that the 'love of wisdom' produces. In a similar article by Miró Quesada [16], entitled 'La filosofía de la lógica de N. C. A. da Costa' (The philosophy of logic of N. C. A. da Costa), Paco expresses his Platonism in the following terms:

> the ascent from the abyss towards the blue skies of rationality does not stop at the viewpoint of intuitionism from which the superior light is already glimpsed. [16, p. 80]

Miró Quesada's mention of intuitionism is made in relation to da Costa's *principle of constructivity*, according to which:

> the integral exercise of reason presupposes that the latter possesses a certain intuitive capacity for constructive idealization, whose regularities are catalogued by intuitionistic arithmetic (including the logic underlying this arithmetic). [16, p. 80]

The English version we print below was translated by us from the original Portuguese, but keeping the aforementioned modifications of the Spanish translation. The reader should bear in mind that Newton refers to Paco as a fully active intellectual because that was his situation around 1990, the time this article was written and published, and Miró Quesada was approximately seventy years old.

As a colophon, we include Paco's reply to Newton [22, pp. 385–389], which reveals his interest in more advanced areas of mathematics by incorporating them into his philosophy of reason and logic, an aspect of his visionary mindset in that field.

Our translation and annotations to this article have been reviewed and approved by da Costa himself, whom we thank for letting us include it in this special issue dedicated to 'his brother', which is how he regarded Paco. We also want to thank Francisco Miró Quesada Rada, Paco's son, for giving us permission to print his father's reply. Finally, we also want to thank Steven French for proofreading the whole article.

Introduction

If I were asked who Francisco Miró Quesada Cantuarias is, I would say very seriously that he is, above all, a magician, eternally young, in love with reason.[1] I cannot go into details to justify the use of the word 'magician', although it is not difficult to mention two cases in which he acted as a true magician.

Several years ago, when I needed a convenient and meaningful name for a logic that did not eliminate contradictions as false from the outset, that is, as absolutely unacceptable, he came to my aid.

Incidentally, it is worth remembering in passing that, at the time, all existing logics condemned contradictions outright.[2] The new logic on which I was working[3] still encountered, then, a lot of resistance, was little disseminated, and those who were aware of it were mostly skeptical towards it.

It was then that I wrote to Miró Quesada, who viewed the new logic with enormous enthusiasm, asking him to suggest (coin, if necessary) a name for it. I remember, as if it were today, that he answered me, making three proposals: it could be called *metaconsistent*, *ultraconsistent*, or *paraconsistent*.[4] After commenting on these possible names, he stated that he found the last one to be the best. To me, the word 'paraconsistent' sounded splendid, and I started using it, also insisting that everyone interested in the subject do the same.

Two or three months later, the miracle was manifest: the term traveled around the world, all centers directly or indirectly related to logic, in the northern and southern hemispheres, began to use it. I think that very few times in the history of science (certainly in the history of logic) has something similar happened, since not only the word travelled around the world, but also the very logic named 'paraconsistent' by Miró Quesada experienced a formidable impulse.[5] It has become one of the most debated logic categories of our time.

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[1] The expression "in love with reason" ("enamorado de la razón") from the Spanish translation [7, p. 69] replaces "whose God is Reason" ("cujo Deus é a Razão") of the Portuguese original [8, p. 293].

[2] It should be noted here that, at one point, Miró Quesada himself argued: "In the whole process [of mathematical thought] the principle of non-contradiction manifests itself with incontrovertible evidence" [11, p. 147]. This attitude towards contradiction, as we know, changed later on [cf. 16], especially under the influence of da Costa's *Ensaio* [6].

[3] Here, da Costa refers to his C_n systems, which he published in a dissertation in Portuguese [4], as well as in some articles in French [3] and English [5].

[4] These names were suggested in a letter dated September 29, 1975 [26, cf. 9].

[5] This was indeed the case, for the term 'paraconsistent' was used, less than one year after Paco's letter, in at least two talks in the III SLALM (Unicamp, July 12-16, 1976): 'On paraconsistent logic', by Elias H. Alves and 'A paraconsistent infinitary propositional calculus' by Carlos Lungarzo [see 1, pp. 358–359]. This event is often cited as the one where Miró Quesada introduced this term to the academic community [see e.g. 27].

A similar thing happened with the word 'paracomplete', also suggested to me by Miró Quesada in an informal conversation I had with him during one of my visits to Lima. Paracomplete logic constitutes a kind of 'dual' logic of paraconsistent logic. In the latter, there can be true contradictions, and in the former the existence of gaps is not excluded, that is, of propositions such that they and their negations are both false. Intuitionistic logic, for example, is paracomplete, as are several of the polyvalent ones. I did not use the word 'paracomplete' immediately after his suggestion. However, when I started to spread it, something like what happened with the term 'paraconsistent' came to pass with it.

I do not think it is an exaggeration to say that, in these two episodes, the name created the thing named. Is this not a miracle, or, if someone prefers, a magical act? Since the answer must be positive, the adjective 'magical' applies to Miró Quesada.[6]

I have also asserted that the Peruvian philosopher is eternally young. There is no obstacle to substantiate this judgment. Those who have the privilege of knowing him personally or reading what he writes, immediately realize that his mind is always open to new ideas, provided they are good ones, and is constitutionally ready to change or rework his theses when there are compelling reasons to do so.[7] Moreover, Miró Quesada tirelessly seeks to help others, particularly the youngest ones, lending a hand to the inexperienced, fighting for their ideals and their innovative conceptions. And he not only defends the legitimacy of other people's positions with ardor, but also of his own theses, distinctly personal; rehearsing, seeking to broaden horizons, without fatigue, without discouragement, with the greatest candor. Do not these traits characterize young spirits, full of life and not yet eroded by the setbacks of daily toil? So Miró Quesada is a young man and, as there are no indications that this attitude will change in the future, I insist that he is eternally young. Ponce de León does not seem to have been completely mistaken at least regarding spiritual youth, which I consider the fundamental one and the one of which I am speaking here. Miró Quesada is glowing evidence of this.

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[6]Newton considers, picturesquely but not without philosophical-metaphysical sense, that Paco was a 'magician' when he asserts that "the name created the thing named"; referring to the episode of Paco having baptized paraconsistent and paracomplete logics, thus giving them citizenship in the fields of logic and philosophy. In a certain sense, a magician is someone who, with his words, is able not only to control 'reality', but also to create it.

[7]A remarkable example is his change of attitude regarding contradiction and the principle of non-contradiction, as we have advanced in footnote 2.

I stated that Miró Quesada's love is reason.[8] In fact, in all his writings, explicitly or implicitly, we come across the subject of reason. The great question that has always vexed him is the following: What is reason? His answer, in a few words, consists in sustaining that reason is the opposite of the arbitrary. Rational is equivalent to non-arbitrary, to the presence of the guiding rule. Herein lies the central intuition of Miró Quesada's thought [see footnote 11].

From this intuition, he starts to examine logic, mathematics, science, law, politics, everything, in short, trying to eliminate the arbitrary and to establish the rational. And he proceeds in this way not only by a theoretical impulse to know, but above all with the intention to contribute to the improvement of the very human condition, since all our ills seem to come from not behaving in a sufficiently rational way, from proceeding in an arbitrary manner most of the time.

Consequently, Miró Quesada's love is reason[8]. The sole object of his love[9] is condensed into the rule that one must always seek the rational, both from the theoretical angle, as well as from the practical one. At certain moments he reminds us of the giants of the Age of Reason, although his stance has much more sophisticated features, given that he is a man of his time.

In this article I intend to discuss some aspects of the Peruvian thinker's conception of logic. But, as we have just seen, there is no doubt that his theory of reason determines his view of logic. For him, logic is identical with the formal part of reason: on the symbolic and formal plane, reason and logic are indistinguishable from each other [see footnote 11]. But one should be careful in sustaining this; for, since there are several alternative logics, must one conclude from this the lack of the unity of reason? For him, the answer is negative. Reason has a basic core[10], common to all logics, which can be extended in different ways, depending on the domain to which reason is applied [see footnote 17]. The existence of heterodox logics, therefore, does not constitute

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[8]The expression "Miró Quesada's love is reason" ("el amor de Miró Quesada es la razón") from the Spanish edition [7, p. 71] replaces "Miró Quesada's God is *Reason*" ("o Deus de Miró Quesada é a *Razão*") of the Portuguese original [8, p. 295].

[9]The expression "The sole object of his love" ("El único objeto de su amor") from the Spanish edition [7, p. 71] replaces "The only commandment of his religion" ("O único mandamento de sua religião") of the Portuguese original [8, p. 295].

[10]The term used by da Costa in the Portuguese original is 'núcleo', which is equivalent to the English 'nucleus' in its sense of 'central part around which other parts are grouped'. In this context, da Costa is borrowing Miró Quesada's [15] use of this term to refer to the central and necessary principles of logic and reason around which other peripheral and contingent ones gravitate; the principle of excluded third, for example, should probably not be considered as part of the 'nucleus' of logic, as it is not valid in several logic systems. Despite 'nucleus' being a good translation of this term that was used by Miró Quesada himself in an article he wrote in English [20, p. 650], using it would force us to translate the corresponding Portuguese adjective, i.e., 'nuclear', as 'nuclear', which conveys odd connotations.

an obstacle to the unity of reason and, in a certain sense, of logic itself. Miró
Quesada wants to seek the logic of the rational core, the logic of logics, the true
pure logic; the rest are applied logics [see footnote 17]. With these theses, he
saves the unity of reason. The logics that are rival to the classical one cause no
trouble to his philosophical stance; on the contrary, they manifest the intrinsic
richness of reason. I will therefore deal here mainly with the Peruvian thinker's
conception of reason, especially with its consequences for logic.

I would like, nonetheless, to place on record in this introduction my great
esteem and admiration for Miró Quesada, whom I consider a brother. I have
never forgotten our first meeting in São Paulo, 1954, when I was still a math-
ematics student, and which was the beginning of our long friendship. I recall
these things so that the reader may understand the scope of this article, where
the feeling of affection surely got in the way of the philosopher. Given his
finesse of spirit, I need not apologize to Miró Quesada.

I would add that I will not go into technical details about his work, but
only about its more general philosophical characteristics, those related to logic
and reason.

1   Reason

'Reason' is an ambiguous term. It has several senses in philosophy. Among
the meanings of the word that interest us, I shall mention the following: (1)
Faculty to conceive, judge, and reason; (2) Capacity for the exercise of critical
reasoning; (3) Set of norms and principles governing rational behavior; (4)
System of rules and principles, of self-evident content, which frame theoretical
activity and practical action; (5) Norms governing the action said to be rational
under conditions of risk.

Miró Quesada does not always use the word under consideration in a de-
terminate sense. It seems that he uses the term in almost all the senses above,
according to the situation he is discussing. In what follows, it will always be
clear in which sense the word will be used.

As I have already stressed, for Miró Quesada 'reason' is opposed to 'ar-
bitrary': rational thought and action cannot be arbitrary. Rational intuition
and critical reflection banish the arbitrary, the unfounded. In other words,
the essence of reason, in any of its forms, lies in the fact that it is founded
on self-evident rules and principles, or derives from them by means of logical
processes. In reality, then, it is evidence, of an intuitive nature, that serves as
the ultimate foundation of the rational and what compels it not to be arbitrary
[see footnote 11].

Logic is but a manifestation of the normative character of reason. Con-
versely, thought must be logical in order to be rational. Logicality is indistin-

guishable from the normative *quid* of reason. If we infringe on logic, we cease to be rational.[11]

What I have just summarized refers, of course, to reason in its role as regulator of thought. But how does the Peruvian philosopher deal with rational action?

Regarding action, Miró Quesada has so far dealt only with its ethical aspect. Ethics embodies reason in the field of action [see footnote 13]. Acts must be ethical in order to merit the qualification of rational, and they are rational because they are subject to ethics. The gist of ethics is summed up in the *autothelic principle*: man must not be a means, but an end [see footnote 12]. Hence, rational action cannot be arbitrary. The justification of the principle is centered on a rational intuition. All this is related, in a rational manner, to the Kantian categorical imperative: Act in such a way that your action may serve as an example to all. The whole of ethics is derived from that starting point, via logic.[12]

The logic, in this case, is a deontic logic.[13] It originates from the already mentioned rational core—or, better, from the corresponding logic—to which we add new concepts and postulates that rule, for instance, the deontic operators of obligatoriness, prohibition, permission, and indifference. The construction is thus derived (or should be derived) from self-evident axioms, with the aid of rules that are also self-evident. In Miró Quesada's works nothing can be arbitrary; in particular, pragmatic criteria such as beauty, simplicity, and explanatory value cannot be resorted to.

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[11]Da Costa begins his analysis of Miró Quesada's philosophy of logic by identifying a relationship between reason and logic when he states that, for him, "reason is the opposite of the arbitrary", which he then complements by saying that, also for Miró Quesada, "logic is identical with the formal part of reason". This last expression subtly gives a certain metatheoretical character to reason in relation to logic, which is further supported by the statements that "it is evidence, of an intuitive nature, that serves as the ultimate foundation of the rational and what compels it not to be arbitrary" and that "[l]ogicality is indistinguishable from the normative *quid* of reason", intuition being in the metatheoretical field and the normative in the formal. This conception will be relevant in the subsequent discussion.

[12] Miró Quesada's first important exposition of his *autothelic principle* was made in his book *Humanismo y Revolución* (*Humanism and Revolution*, 1969) [12] and these theses were later developed in other works such as his 'Ensayo de una fundamentación racional de la ética' (Essay of a rational grounding of ethics, 1989) [21]. See also footnote 28.

[13]Da Costa refers to the rational aspects of action in Miró Quesada, which he summarizes in the statement: "Ethics embodies reason in the field of action." The logic that corresponds to this conception of ethics is a deontic one. Incidentally, Paco was a pioneer in the fields of deontic and legal logic with his article 'La lógica del deber ser y su eliminabilidad' (The logic of ought-to-be and its eliminability, 1951) [13], written the same year in which von Wright's paper 'Deontic logic' [33] appeared, but published only in 1972. In Section 3, da Costa describes other possibilities for the treatment of action that Miró Quesada had not addressed. Also see Section 4 of C. A. Serbena's contribution to this issue [28] for some remarks the absence of the development of a paraconsistent deontic logic in Miró Quesada.

For the impenitent rationalist that is Miró Quesada, the problems of rational action (ethical problems), logic, and reason are inextricably intertwined. However, I will not deal here with his ethical ideas.

2   Logic

Deductive logic, or just logic, is divided into two broad regions: that of classical logics and that of non-classical logics.[14]

The basis of classical or traditional logic is first-order predicate calculus (with or without equality). This calculus is extended in two ways: through type theories and through set theories.

It is now known that these various extensions of the classical predicate calculus are not mutually equivalent, especially after the appearance of the set theories that Cohen proposed to name 'non-Cantorian'. The *grand logics* thus obtained, whether by means of type theories or by means of set theories, give rise to different mathematics. Thus, for instance, in the so-called metaphysics of Solovay, every subset of a line is measurable according to Lebesgue, and Hilbert's theory of spaces, based on it, differs from the classical one. All this highlights the fact that classical logic is not a well-defined field.[15]

On the other hand, non-classical logics encompass those that complement the classical (such as the traditional temporal logic) and heterodox logics, which diverge from the classical one [see footnote 16]. Intuitionistic, paracomplete, and paraconsistent logics fall among heterodox logics.

The existence of so many alternative logics, particularly heterodox ones, causes problems for the philosopher who wishes to formulate an organic and systematic conception of Aristotle's science. But I have already shown how Miró Quesada tries to overcome this difficulty: there is a fundamental core logic, the true pure logic, and the others would be applied ones. This implies to consider heterodox logics as, under certain aspects, complementary to classical

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[14]The original says "a das lógicas e a das lógicas não-classicas" (that of logics and that of non-classical logics) [8, p. 297], which is obviously a mistake. The Spanish translation corrects this printing "la de las lógicas clásicas y la de las lógicas no clásicas", which is the fragment we translate [7, p. 74]. Note, however, that da Costa is here speaking about classical logics in plural, and not in singular. We will say more about this in footnote 15.

[15]This point had already been made by da Costa in his *Ensaio*, where he states that the expression "classical logic" [6, p. 133] and the "common expressions" of the classical laws of logic [6, p. 111] are "vague". He even goes so far as to state the following: "There are several grand logics—all of which deserve to be qualified as classical—not equivalent to each other" [6, p. 94]. As we advanced in footnote 14, da Costa seems to hold the view that there is not just one classical logic, but many of them.

logic, and not as rivals.[16] This position does not seem to me to be wrong: with some argumentative effort it can be justified.

It can be seen, therefore, that Miró Quesada has two basic tasks for being able to place his conception on a firm underpinning. The first is to show that there is a core logic whose principles are self-evident. The second is to show that the various logics are only alternative ways of extending the logic of the rational core.[17] This last task is equivalent to showing that the various logics are no more than calculi complementary to the basic core, and its achievement does not seem impossible to me.

Although the two previous tasks show themselves to be Herculean ones, Miró Quesada has already taken some initial steps towards accomplishing them. There are enormous obstacles, and it is enough to cite just one of them: the basic logic must have a kind of implication that is not subject to the paradoxes of the common implications, such as the material and Lewis' strict implication [cf. 18]. Obtaining such an implication relation is difficult enough in itself, but what is worse is that, even if it is formalized, it cannot serve as a basis for the construction of strong grand logics, say, a sensible set theory[18], because

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[16]Here, da Costa seems to understand the concept of 'heterodox logic' as synonymous with 'logic divergent from or rival to classical logic'. This does not coincide with Miró Quesada's [15] definition, from whom da Costa takes the concept. In Miró Quesada's definition, for a logic to be heterodox, it is enough, for example, that it be *aliolinguistic*, i.e., that its formal language be different from those of classical systems (e.g., propositional or first-order). Traditional modal logic is, hence, an aliolinguistic logic and, therefore, heterodox, but not a rival to classical logic. Therefore, 'heterodox logic' is for Miró Quesada synonymous with 'non-classical logic' in the broad sense presented by da Costa, which encompasses logics that are complementary as well as rival or divergent to classical logic. Later, da Costa invites us to "to consider heterodox logics as, under certain aspects, complementary to classical logic, and not as rivals", but this is said in the context of the articulation of classical logic and its rivals in what, in his understanding, would be Miro Quesada's "fundamental core logic". In this respect, see the third paragraph of Miró Quesada's reply (p. 202 of this article).

[17]In these fragments, da Costa points out what he considers a central idea of Miró Quesada's theory of reason: "Reason has a basic core, common to all logics". However, da Costa later argues that one of Paco's main tasks will be to search for the logic of that common core "whose principles are self-evident". Regarding the existence of such a core logic, see the first three paragraphs of Miró Quesada's reply which we reproduce at the end of this article.

[18]When da Costa discusses with Miró Quesada whether basic core logic "must have a kind of implication that is not subject to the paradoxes of the common implications", he reveals his position that a "strong logic" must contain a set theory. This is because he claims that with such an implication it is not possible to construct "strong grand logics, say, a sensible set theory". Miró Quesada had already observed, in a footnote, that: "For da Costa, set theory is something like a grand logic within which mathematics can be founded" [16, p. 74], a position that in a way extends the logicism of Frege and Russell. In this respect, Miró Quesada was still of the opposite opinion in the 1960s. In a conversation with the Peruvian logician J, B. Ferro, Miró Quesada stated: "My point of view was that logic should not encompass set theory. ... For me, at that time, logic had to be absolutely general, that is, it did not have to contain any 'matter' among its topics. ... I told [Ferro] that set theory

it can be proved that, in order to do so, the implication has to possess some properties of the material implication, which lead us directly to the paradoxes of the material and strict implications.

At this point, Miró Quesada's work is still unfinished. But his critique of certain extrapolations apparently resulting from the existence of intuitionistic logic seems correct to me. In summary, he believes that intuitionistic logic does not entail that the excluded third is false. Nor do I think that the referred logic has shown that the classical version of the *tertium non datur* is false, since classical and intuitionistic logics apply to different semantic situations. What is meant when it is stated that intuitionistic logic has derogated the excluded third is the following: it is possible to have an extremely powerful logical system, with convenient and plausible semantics, in which the principle does not hold. Nothing more than that [cf. 17].[19] Something similar happens with Euclidean and non-Euclidean geometries and Euclid's postulate.

There are still some questions I wish to air. When we speak of logic, without any qualification, it is understood that we are referring to deductive logic, classical or otherwise.

Nevertheless, the deductive dimension of logic does not exhaust the whole operative part of rationality. In fact, in daily life and in science, perhaps the most relevant reasoning that is done is non-deductive. Without non-deductive, that is, inductive inference, human life on this miserable planet would have already ended; specifically, there would be no empirical sciences, technology, and other daily activities.

Among the forms of inductive inference, we highlight: simple enumerative induction, eliminative induction, analogy, the hypothetical-deductive method, Bayesian statistical inference, and traditional statistical inference. Obviously, whoever discourses on reason, and defends the thesis that logic reflects a good portion of it, cannot forget inductive logic, nowadays, incidentally, undergoing explosive evolution. The rational person proceeds rationally both from the deductive point of view and from the inductive one.

So far, Miró Quesada has not had time to analyze inductive thinking. Thus, the existence of several alternative inductive logics has not been addressed by him. Nevertheless, it could be argued, extending his position, that all inductive

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could only be considered as logic when it was limited to being an [abstract/formal] theory of Boolean sets" [23, p. 378]. Note that, at that time, Miró Quesada considered mathematics, especially set theory, as a 'material' rather than as a 'formal' science, as logic would be.

[19]Regarding Heyting's formalization of intuitionistic logic, Miró Quesada himself said that it was "a kind of stenography that helps to understand some of the dynamism of reason when it discovers mathematical truths. But nothing more." He also said that this formalization "does not constitute, therefore, a counterexample against the traditional belief in the unity of logic" [16, pp. 71–72]. Thus, for Miró Quesada, intuitionism highlights the dynamism of reason independently of the fetters of any logic.

logics possess a basic core which, as in deductive logic, composes the inductive logical counterpart of the core of reason [see footnote 20].

In sum, Miró Quesada's conception of logic is still developing.

3 Action

Leaving aside the investigation of action from the ethical angle, there is another way of looking at it: that of decision theory, a corpus of doctrine that has progressed prodigiously in our time.

When we are going to perform an act, among several possible ones, rationality imposes restrictions on us, dictated by decision theory, at least in part. We need to evaluate certain probabilities, rewards, and risks, even if in an imprecise way. There are several theories of decision, one of them being the Bayesian theory.

Since rationality in the broad sense, as we have seen, involves rational action, in accordance with decision theory, a complete analysis of rationality must necessarily take into account the underpinnings of this theory. And as rationality, for Miró Quesada, is the final determinant of logic, it seems sensible that a philosophy of logic like his cannot turn its back on the logic of action, which is included among the complementary logics of any deductive logic adopted as the basic one. However, it is obvious that, since there are several conflicting positions in this area, things are complicated for those aspiring to a unified and ultimate theory of logic and reason.

Once again, we come across subjects on which the Peruvian thinker has not yet spoken.

4 Concluding Remarks

From the brief exposition above, we conclude that Miró Quesada's theory of logic (and reason) is not finished, a fact that he himself acknowledges. Nevertheless, I have the impression, if I understood it correctly, that it is fundamentally correct, although I do not accept it *in totum*.

If we use the word 'logic' in a broad sense, encompassing deduction, induction, and the logic of action, I believe that rationality and logicality coincide to a great extent.[20] Moreover, reason and logic have a basic core, underlying all rational activity. In this sense, reason and logic are not arbitrary.

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[20]Even though "Miró Quesada has not had time to analyze inductive thinking", da Costa includes induction within the scope of logic in the statement we note here because he previously stated that it was possible to conclude, extending Paco's position, that "all inductive logics possess a basic core which, as in deductive logic, composes the inductive logical counterpart of the core of reason".

And here arises one of my divergences with the Peruvian philosopher: for him, the core is founded on self-evident and immutable principles, which we gradually become aware of. For me, on the contrary, portions of the core depend on pragmatic factors; what is more, the core itself is not well determined, being susceptible of being codified by logical systems that are not mutually equivalent.

Another topic on which Miró Quesada and I disagree lies in the historicity of reason. For him, reason is essentially absolute [see footnote 21]. This, of course, does not imply that we know today what all the logical-rational principles are or that it is possible for us to foresee them. Nevertheless, they do exist in some way, and little by little we get to know them. While science changes and knowledge is transformed, something slowly becomes more and more evident: the structure of the rational and the logical. Everything happens like when we develop a photograph: the traces are gradually shown, although they were already there, more or less hidden.

My position is more radical: I think that reason (as well as logic) is being constructed in the course of history.[21] We do not discover, so to speak, the logical principles, they arise from the interaction between us and our surroundings, depending, for example, on pragmatic conveniences. The very concept of self-evidence has a historical counterpart, etc. If this conception were not the true one, I do not know how any other would be legitimized. (On these questions, see my *Essay on the Foundations of Logic* [6].)

I do not consider it appropriate to continue the critical analysis of Miró Quesada's conception, an analysis that would only reflect my position. What

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[21]One of the most controversial issues in the debate/dialogue between Miró Quesada and da Costa is that of the historicity of reason and logic, especially in relation to the universal and absolute character of rational and logical principles. Miró Quesada expounds this dialogue at length in an article [16] motivated mainly by da Costa's *Ensaio*. Newton states that, while for Paco "reason is essentially absolute", his position is more radical, since he thinks "reason (as well as logic) is being constructed in the course of history". According to Miró Quesada, a "first step in the climb towards rationality [in Newton] is that reason, although it does not have universal and necessarily valid principles, nevertheless has pragmatic principles, that is, principles by means of which it confronts reality in order to systematize it and make it theoretically accessible" [16, p. 79]. Newton's historicism, however, shows itself finally flexible, according to Paco, getting closer to his ideas when "at the end of his research, [Newton] surprisingly accepts the thesis [that,] although reason is historical, throughout its evolution it has maintained some immutable characters", with which there would be "a core of invariable rationality that is being formed throughout history, and this core is constituted both in relation to some categories that impose certain guidelines to thought, and in logic itself" [16, p. 82]. Paco concludes poetically and affectionately that, despite "his firm historicist conviction", Newton "feels, perhaps without confessing it, that the thesis destroys itself and is seduced by the siren's songs of reason: he listens to the distant but irresistible whisper of the absolute, of supra-historical validity" [16, p. 84].

is of real interest is that he has begun to develop a very important theory of logic and, in general, of rationality, even though he has not yet completed it.

But, as I have already made clear, Miró Quesada is a young man, despite his seventy years, and moreover a magician. Undoubtedly, he will have the strength and disposition to retouch and give the final brushstrokes to his conception of logic and reason. And the young Peruvian surely will continue serving his beloved reason[22], sculpting a work that is a source of pride for all of us in Latin America.

Reply by Francisco Miró Quesada Cantuarias (†)

N. C. A. da Costa's fundamental objection is that I propose a core logic which is universal and to which all others would be complementary. In this sense, classical logic would mean a serious problem, if it were so, the material implication of this logic would have to be a particular case of the core implication, which is impossible. Indeed, the implication of core logic must not present paradoxes like those of the material implication of classical logic. However, without material implication it is not possible to construct the whole of classical set theory.

Actually, I have never said that the various logics should be considered as particular cases (applied logics) of a core logic. What I have said is that there is a level of analysis at which it is impossible not to use certain logical principles, otherwise we would not be able to understand each other. There are certain principles of intelligibility without which we cannot structure any system of logic. For example, according to paraconsistent logic the principle of non-contradiction may be invalid. That is, there can be two true contradictory propositions.[23] The typical example is the paradoxes of set theory. There are even aspects of reality that could be contradictory, for example, certain facts of the quantum world. But when we talk about a system that presents contradictions, we must use a non-contradictory logic. Because then the system you are talking about would be and would not be contradictory [see footnote 24]. There has to be, therefore, some kind of coherence in the metalanguage. Of course, one could think that the metalanguage employed is also contradictory but not trivial. But then we fall into a *regressus*. After all, we have to use the

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[22]The expression "will continue serving his beloved reason" ("continuará sirviendo a su amada razón") from the Spanish translation [7, p. 78] replaces "will continue serving his God, Reason" ("continuará a servir seu Deus, Razão") of the Portuguese original [8, p. 301].

[23]This is, of course, a philosophical interpretation of paraconsistent logics by Miro Quesada. But the existence of these systems may be interpreted as nothing more than the proof that we can reason with contradictory information, which we take as false anyway.

principle of non-contradiction: the theory that is being analyzed has certain characteristics and we cannot think that it does not have them.[24]

Fundamental logic is not, thus, a system of which the others are particular, but it is what makes it possible to speak intelligibly of the properties of theories. After believing that my thesis was original, it was a disappointment to learn, thanks to N. C. A. da Costa and Ayda Arruda, that the great Russian logician Vasiliev [31] had reached the same conclusion in 1910. But then I consoled myself with the thought that I had agreed with him. After all, Vasiliev was a great logician and, although I am a third-class logician, I was very flattered to have reached the same conclusion as he did.[25]

The universality of reason is manifested in the relation of logic with the various sectors of reality or of the ideal world. Reason explores a certain sector and, to do so, it needs a certain logic. Thus, in order to develop classical mathematics and set theory, classical logic is created. But when one begins to explore the world of the constructive, it is necessary to resort to intuitionistic logic. This allows us to infer that there is a close relationship between logic and ontology. And so it is, indeed. For example, the analysis of temporal propositions requires the use of a temporal logic that has a modal structure [see footnote 26].

A remarkable example of this deep relation is what happens with the study of topoi. We see that each topos has an internal logic necessary to study its properties and that, in addition, there is a general internal logic of the topoi, which is the intuitionistic logic [see footnote 26].

When the region under study is not propositional, for example, when we are dealing with ethical or legal norms, the process is similar, although, in these cases, we cannot speak of an ontology. What induces the elaboration of a logic is the structure of the region we want to investigate.[26]

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[24]Miró Quesada's requirement for metalanguage coherence suggests that, although the principle of non-contradiction cannot be valid in all logics, it probably needs to be valid in all metalogics. This is related to the result, independently discovered by Suszko [30], and Kotas and da Costa [10], commonly known as 'Suszko's thesis': all logics have a two-valued semantics. From this result, Batens has argued, in line with Miró Quesada, that "paraconsistent systems are not adequately described by paraconsistent means" [2, p. 225].

[25]Up to this point, we can appreciate Miró Quesada's reply regarding the existence of a core logic, which we pointed out in footnote 17.

[26]In Miró Quesada's article entitled, 'Logic, mathematics, ontology' (1997), which was published well into his seventies, he concludes, among other things, that logic can be "content-dependent", which means that we can no longer consider it "ontologically (or objectually) aseptic" [24, p. 27]. Seven years later, already in his eighties, he published an article entitled, 'Does metaphysics need a non-classical logic?', where, after showing examples of application much in the way he does in these fragments, he concludes by answering: "Yes, it does!" [25, p. 37]. In these articles, especially in the first, the arguments presented by Miró Quesada in this reply to da Costa find their most accomplished form.

The situation is as follows. Human reason (or, more precisely, the cognizant subjects that use their reason) advances in the cognitive conquest of diverse regions of the world (real or ideal). As it advances, it discovers different contents, and this discovery induces a given logic. The fact that there are formal coincidences between the diverse systems of logic is due to the fact that reason has a basic structure that manifests itself in its diverse dynamisms.

But the remarkable thing about this process is that it is not an empirical process in which reason would elaborate hypotheses about the studied field that would be verified, later, by a kind of experimental control. What is remarkable is that *it is an a priori elaboration*. When reason grasps a new region of objects, it also grasps what kind of logic it should use to theoretically study this region.

Of course, the question can be asked: which comes first, the logic or the ontology? Is not the ontology imposed by the logic itself? There is no doubt that a given logic imposes an ontology (or a set of ontologies) that corresponds to that logic and that allows it to be studied in an optimal way. Historically, the emergence of logics with their respective ontologies has occurred naturally and it can be said that they have been born mutually intertwining.

But when one studies the topoi, one sees, clearly, that the ontology is determined first and then the logic. Thus, the category of real functions is a topos with a trivalent internal logic, and the category of monoidal action has, as an internal logic, a bivalent but not a classical logic. It is, then, the determination of the objective region according to certain procedures that demands a certain logic. And the possibility that reason is capable of finding it *a priori* constitutes a fundamental aspect of rationality. The fact, not sufficiently observed, of the possibilities of reason to find the logical system that suits a given ontology (sometimes many) shows a new type of *a priori*. It is an *a priori* which is constituted in relation to something objective and which can be considered as the grasping of the most general features of the objective region discovered.[27] We see, then, that there is no problem of the basic logic (which N. C. A. da Costa calls 'core') being opposed to any of the more particular logics. The first is used to speak about the more particular logics, but it is not a general logic from which the others can be derived by specification.

N. C. A. da Costa is right that I have not dealt with inductive logic, nor with the logic of action. This is because the study of deductive logic and the philosophy of mathematics has taken me a long time and I have not yet been able to deal with the topics mentioned.

Another observation of N. C. A. da Costa is that I use the term reason without clearly distinguishing the sense in which I use it. But in fact, in investigating the way in which reason proceeds in the logical-mathematical field, I presuppose that the term 'reason', although it has a very broad field of

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[27]Miro Quesada's theses on *a priori* knowledge of math and logic are developed in [19, 24].

application, applies clearly to that field. No one can doubt that reason is the means whereby human beings create or discover logic and mathematics. Nor can there be any doubt that reason is involved in the elaboration of scientific knowledge.

Of course, reason performs other activities, for example, practical activities. In this case, too, I have applied the term clearly, for I have shown how a behavior, to be ethical, must be based on *non-arbitrary* decisions that are universally accepted [see footnote 28].

Moreover, da Costa says that I only deal with the ethical aspect of reason. But this is not so, for in some recent works I deal with the relationship between ethics, law, and politics, and show how the latter two, in order to be rational, must be grounded on ethics [21].[28]

Generally speaking, it can be said that reason functions as a lighthouse that illuminates the territories it explores. When this territory is ontological, it intuitively captures its most general features. The most general ones are those that constitute the logic of the region studied; then, the less general ones, which cover a very broad field of the region, are the mathematical properties that serve as a starting point for deriving, by means of logic, new mathematical properties.

When it comes to regions that are not ontological, such as norms (which do not describe but prescribe), the language used reveals the logic to be used. Of course, language also reveals the logic of ontological regions, but it does so because it is adapted to ontology. In the non-ontological regions, on the other hand, language imposes the logical structure because it does not have an objective reference, but is used to create a situation that does not yet exist. This is observed on the semantic level. While propositions refer to truth (even if they are multivalent), in norms, for example, they refer to justice, validity, or convenience [see footnote 29]. Thus, in propositional deduction one goes from the truth of the premises to the truth of the conclusion; while in normative deduction one goes from the justice or validity of the premises, to the justice or validity of the conclusion. But in all cases the determination of logic is *a priori*, derived from a mere conceptual analysis.

The logics described are the regional logics, which apply to specific objective (which may be very broad) or linguistic regions. The basic logic is the one that governs the very functioning of the *a priori* grasping of the regional logics. It is the logic with which we use the light of the lighthouse that illuminates

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[28]These Miró Quesada's ideas are presented and analyzed in A. Villarán's contribution to this collection [32], which discusses the relationship between reason and ethics in his thought.

the different regions when focusing on them. Its properties are determined, likewise, *a priori*.[29]

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[29]These fragments present the gist of Miró Quesada's *transmissive logic* [14], which is a logic whose semantics is not based upon the alethic concept of 'truth' but upon the more general concept of *signedness*. Logical deduction is not defined there as the transmission of *truth* from premises to conclusion, but of a *signed value*. Transmissive logic has, thus, as special cases not only alethic logics, but also deontic, epistemic, and any other kind of athethical logics [cf. 15], i.e., logics whose sentential variables do not range over propositions.

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