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ARISTOTLE'S MATHEMATICAL CYCLISTS

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Abstract
Quine objected to Aristotelian essentialism and he objected to modal logic generally. Quine is unable to make sense of a view he attributes to Aristotle — that properties can apply by necessity to things independently of how they are described. Aristotle scholars have considered ways Aristotle might answer Quine's objections to essentialism, but their focus is metaphysical issues and they say little about modal logic. This paper looks at examples from Aristotle which make Quine's point about mathematical cyclists and then shows that Aristotle, *qua* modal logician, is aware of Quine's problems.

Quine tells us that he is unable to make sense of a view which he attributes to Aristotle — that properties can apply by necessity to things independently of how they are described. Quine objected strenuously to 'Aristotelian essentialism' and he objected to modal logic generally. Aristotle scholars have considered ways Aristotle might answer Quine's objections to essentialism.[1] They are on the whole concerned with metaphysical issues, and they tend not to discuss modal logic specifically. This leaves a gap in the discussion, since in addition to advocating a version of essentialism, Aristotle also invented modal logic in the form of his modal syllogistic. The purpose of this paper is to investigate the attitude of each of Quine and Aristotle to modal logic, and to set their views out so that they can be closely compared. On the face of it, this might seem straightforward and not an especially interesting task that I have set myself. But there is more to the story than that Aristotle invented modal logic and that Quine objected to modal logic. There are as we shall see examples in Aristotle's own works which appear to make Quine's point about mathematical cyclists and which therefore raise a question about whether Aristotle, *qua* modal logician, is aware of Quine's problems.

[1] See for example Code (1976), Matthews (1982, 1990), and Williams (1985).

Aristotle clearly gives a metaphysical theory which we appropriately describe as a basic form of essentialism. Things in the world have essential natures; things have attributes which are necessary to them. Things in the world also have other merely accidental attributes. These accidental attributes fall short of necessity and are only contingent. They may happen to belong to a thing but there is no necessity about it. For the Aristotle scholar there are important questions about how to understand and define what is an essential attribute, what is merely accidental, how the two are related, and so on. Aristotle's discussion of modal syllogistic is peppered with examples of essential and accidental attributes, such as the following:

(1) Being an animal is essential to a horse. A horse cannot fail to be an animal — i.e., a horse is necessarily an animal.

(2) A horse might be dapple gray or black; it might be moving or standing still. These attributes are merely accidental, or coincidental. A horse is contingently black, because even though it is black it could have been otherwise.

Consider (1). If you take animal away, then you no longer have horse. Nothing is a horse that is not also an animal. But (2) is different. You can take black away and still have a horse. From the point of view of the logic, we can treat 'accidental', 'coincidental' and 'contingent' in (2) as equivalent expressions.[2] Examples like (1) and (2) are routine in *An Pr*.[3] And these examples make it clear that Aristotle is concerned with *things*. In his metaphysics *things* have essences, and *things* can also have accidental attributes. But Quine objects even to this much.

Quine tells us that he is unable to make sense of the view that properties can apply by necessity to things independently of how they are described. He describes "an invidious attitude toward certain ways of uniquely specifying [an object] x... and favoring other ways... as somehow better revealing the 'essence' of the object". (Quine, 1953, p. 155) This is a "reversion to Aristotelian essentialism", according to which "an object, of itself, and by whatever name or none, must be seen as having some of its traits necessarily and others contingently...." (p. 155) Quine objects to showing "favoritism among the traits of an object". (p. 155) In Quine 1960, Quine describes as

[2] From a *logical* point of view these are equivalent, and in the modal syllogistic we have to treat them as such. Classical scholars discuss the variety of modal expressions in Aristotle's Greek. See, for example, Sorabji (1980) and Smith (1989).

[3] See, for example, *An Pr* 26a2–9, 31a37–b10, 34b7–18.

'baffling' "talk of a difference between necessary and contingent attributes of an object". And he tries to share his bafflement with the rest of us in the tale of the mathematical cyclist:

> Perhaps I can evoke the appropriate sense of bewilderment as follows. Mathematicians may conceivably be said to be necessarily rational and not necessarily two-legged; and cyclists necessarily two-legged and not necessarily rational. But what of an individual who counts among his eccentricities both mathematics and cycling? Is this concrete individual necessarily rational and contingently two-legged or vice versa? Just insofar as we are talking referentially of the object, with no special bias toward a background grouping of mathematicians as against cyclists or vice versa, there is no semblance of sense in rating some of his attributes as necessary and others as contingent. Some of his attributes count as important and others as unimportant, yes; some as enduring and others as fleeting; but none as necessary or contingent.
>
> Curiously, a philosophical tradition does exist for just such a distinction between necessary and contingent attributes. It lives on in the terms 'essence' and 'accident', 'internal relation' and 'external relation'. It is a distinction that one attributes to Aristotle (subject to contradiction by scholars, such being the penalty for attributions to Aristotle). But, however venerable the distinction, it is surely indefensible... (Quine 1960, p. 199)

Quine's last few lines here are perhaps a bit cavalier. He does not show himself to be much interested in what precisely Aristotle says, and in fact Quine uses 'Aristotelian essentialism' as little more than a label.[4]

Quine objects to talking about *things* — about ordinary and real *objects* in the world — in the way that Aristotle talks about them. Quine cannot countenance the notion that things have different kinds of attributes, some of them necessary and some merely accidental, and this affects his views about modal logic. He thinks quantified modal sentences are meaningless: "necessity does not properly apply to the fulfillment of conditions by *objects*... apart from special ways of specifying them." (Quine 1953, p. 151) So, the following sentences

(3) All mathematicians are necessarily rational
(4) All cyclists are contingently rational

[4] This has been noted by others. See, for example, Matthews (1990, p. 251).

cannot, according to Quine, be interpreted as requiring *de re* necessity. And so Quine rejects the following modal predicate logic formulas, with L for necessity, M for Aristotle's sense of possible according to which $\mathsf{M}\varphi$ is $\sim\mathsf{L}\sim\varphi$, and Q for contingency, where $\mathsf{Q}\varphi$ may be defined as $\mathsf{M}\varphi \wedge \mathsf{M}\sim\varphi$:[5]

(5) $\forall x(Mx \supset \mathsf{L}Rx)$
(6) $\forall x(Cx \supset \sim\mathsf{L}Rx)$

From (5) and (6) we get $\exists x(Mx \wedge Cx) \supset \exists x(\mathsf{L}Rx \wedge \sim\mathsf{L}Rx)$, and so $\sim\exists x(Mx \wedge Cx)$. So given at least one mathematical cyclist, (5) and (6) cannot both be true. Why should we take (5) and (6) to be true? Maybe we are confusing them with the following:

(7) $\forall x\mathsf{L}(Mx \supset Rx)$
(8) $\forall x\sim\mathsf{L}(Cx \supset Rx)$

(7) and (8) may well be true but they do not yield the conclusion that there are no mathematical cyclists.[6] So, whatever the status of Quine's views on modal logic, the mathematical cyclist argument is not a good one. Quine of course has objections not only to 'Aristotelian essentialism' but also to quantified modal logic, whose legitimacy he doubts.

Consider, then, how essentialism features in Aristotle's modal logic. After he invented logic — the simple syllogistic set out in *Prior Analytics* A1–7 — Aristotle went on to extend it and to investigate a specifically *modal* version of his logic. This modal syllogistic is set out in *Prior Analytics* A8–22. Aristotle studies how and when a conclusion logically follows from premises involving what is necessary or involving what is possible. Aristotle, however, does not offer a formal analysis to explain the structure of his modal propositions, and so how to represent and understand them becomes an interpretive question. Scholars tend to agree that *de re* modality is required.

[5] Aristotle routinely distinguishes between possible 'according the stated determination' [Q] and 'not of what is possible according the determination' [M]. To see how careful his language is compare, e.g., *An Pr* 32a19–22 and 33b25–28.

[6] We can see this in the following simple possible worlds model with one individual a and two worlds w_1 and w_2, where a is a (rational) mathematician and a cyclist in w_1 and is a cyclist but neither rational nor a mathematician in w_2. Then a is rational in all worlds in which a is also a mathematician — making (7) true — but not rational in all worlds in which a is a cyclist — making (8) true. Nevertheless a is (in w_1) a mathematical cyclist. Of course if (7) and (8) hold, it cannot be necessary that there is a cycling mathematician, but nothing in Quine's example suggests there could be.

The evidence in favour of *de re* modality is due not only to Aristotle's underlying essentialist metaphysics, but also to the fact that when we begin to put modal premises into syllogistic schemas, then, at the formal level the schemas themselves seem to demand *de re* modals. I prefer to use modern predicate logic to represent Aristotle's propositions, and modal predicate logic for his modal propositions.[7] So when we meet Aristotelian modal premises such as

(9) Every horse is a necessary animal
(10) All horses are contingent movers

I will represent these as involving *de re* modality, where L stands for necessity, and Q stands for contingency:

(11) $\forall x(Bx \supset \mathsf{L}Ax)$
(12) $\forall x(Bx \supset \mathsf{Q}Ax)$

A look at *Prior Analytics* shows how such modal premises work in the syllogisms. Consider, for example, the following passage. In it Aristotle is describing the validity of a syllogism usually called Barbara LXL:[8]

> *AnPr* A9, 30a18–23:
> For instance, if A has been taken to belong... of necessity to B, and B merely to belong to C: for if the premises have been taken in this way, then A will belong... to C of necessity. For since A belongs...

[7] I use lower predicate logic (LPC) to interpret Aristotle because everybody understands LPC. Ebert and Nortmann (2007) and Schmidt (1989) also use LPC, though our translations differ in some cases. There are of course fundamental questions about the appropriateness of LPC for the job, particularly because it is more powerful than anything Aristotle has to hand, and many scholars eschew LPC representations for this reason. They point, for example, to the fact LPC introduces devices such as the individual variable which clearly go beyond anything we find in Aristotle. But, this objection is easily answered: if we are only using LPC to represent Aristotle's propositions, and not attributing LPC to him, then there is no real problem using it. See Rini (2010) for a more detailed explanation.

[8] Medieval scholars used the name 'Barbara' to encode instructions for Aristotle's proof. See Smith (1989, pp. 229–230) for an explanation of the medieval mnemonics. McCall (1963) provides the standard system of classifying the modal syllogisms. In this system an assertoric (non-modal) proposition is denoted by X, a proposition about necessity by L, and a proposition about possibility by either M or Q depending on the kind of possibility involved. Thus, Barbara LXL is Barbara with the first premise a necessary proposition, the second premise assertoric, and the conclusion necessary.

> of necessity to every B and C is some of the Bs, it is evident that [A] will also apply to C of necessity.

Aristotle tells us this is a valid syllogism. And using LPC with *de re* necessity Barbara LXL does come out valid:

Barbara LXL

(13)	$\forall x(Bx \supset \mathsf{L}Ax)$	A belongs of necessity to every B
(14)	$\underline{\forall x(Cx \supset Bx)}$	and B merely belongs to C
(15)	$\forall x(Cx \supset \mathsf{L}Ax)$	then A will belong to C of necessity

It does not come out valid if we use *de dicto* necessity in the modal premise. Putting terms in helps to highlight the difference between *de dicto* and *de re* interpretations. Aristotle regularly offers terms in order to illustrate invalidity. The terms animal, man, and moving seem to be some of his favourites, so let us use those to study the syllogism. Of course when we put terms into (13)(14)(15), all we get is a valid instance of Barbara LXL:

Barbara LXL

(16) All men are necessary-animals
(17) <u>All moving things are men</u>
(18) ∴ All moving things are necessary-animals

But terms make clear that *de dicto* necessity does not get the right results:

(19)	Necessarily (all men are animals)	T
(20)	<u>All moving things are men</u>	T
(21)	Necessarily (all moving things are animals)	F

The *modal* proposition (21) is *false* because it is not *necessarily* the case that all moving things are animals. Moving is possible but not necessary to any animal. 'Moving' is one of Aristotle's stock examples of a predicate which may hold of a subject, but not by necessity. Animals may have the capacity to move but, according to Aristotle, no animal moves of necessity, *An Pr* 30a30–33. So a syllogism that Aristotle says is valid — Barbara LXL — does not come out valid when we translate using *de dicto* modal propositions, but it does come out valid when we translate using *de re*. Since Quine objects to *de re* modals, he will object also to Aristotle's modal syllogistic if it requires *de re* modals.[9] And so perhaps we want to say, as Quine seems

[9] Barbara LXL is a convenient example, but there is an important and I think frequently overlooked question about whether, e.g., Barbara LXL is in fact a *modal* syllogism at all, or

to, 'end of story' — that is, perhaps we want to say that the fact of the matter is that Quine and Aristotle are on opposite sides of the fence and that is all there is that is interesting to say. Certainly, they do not agree about what we call *de dicto* and *de re* modal propositions. But that is not all there is to the matter, and that is what I want to turn to now.

Quine's puzzlement about the mathematical cyclist comes down to the way we analyse his various attributes — some are necessary and some are contingent. Look at what Aristotle has to say about how to handle his own very similar example.

> *Metaphysics* VII (Z) 4:
> But since there are also compounds answering to the other categories (for there is a substratum for each category, e.g. for quality, quantity, time, place, and motion), we must inquire whether there is a formula of the essence of each of them, i.e. whether to these compounds also there belongs an essence, e.g. to 'white man'. Let the compound be denoted by 'cloak'. What is the essence of cloak? But, it may be said, this also is not [said of something in its own right]. We reply that there are just two ways in which a predicate may fail to be true of a subject [in its own right], and one of these results from the addition, and the other from the omission, of a determinant. *One* kind of predicate is not [said of a thing in its own right] because the term that is being defined is combined with another determinant, e.g. if in defining the essence of white one were to state the formula of white *man*; the *other* because in the subject another determinant is combined with that which is expressed in the formula, e.g. if 'cloak' meant 'white man', and one were to define cloak as white; white man is white indeed, but its essence is not to be white.
> But is being a cloak an essence at all? Probably not. For the essence is precisely what something *is*; but when an attribute is asserted of a subject other than itself, the complex is not precisely what some 'this' *is*, e.g. white man is not what some 'this' *is*, since thisness belongs only to substances. Therefore there is an essence only of those things whose formula is a definition. But we have a definition not where we have a word and a formula identical in meaning (for

just a special instance of a non-modal Barbara with modal terms. Kneale and Kneale (1962) note this possibility. Rini (1998) explores it in detail, and Rini (2010) shows that even if much of Aristotle's syllogistic about necessity can be analysed as non-modal syllogisms involving special modal terms, many of his syllogisms about contingency cannot be analysed this way, since they depend upon genuine modal logic about what in LPC are *de re* modals. In the discussion below we look at one such fundamentally modal syllogism, called Barbara XQM.

> in that case all formulae or sets of words would be definitions; for there will be some name for any set of words whatever, so that even the *Iliad* will be a definition), but where there is a formula of something primary... Nothing, then, which is not a species of a genus will have an *essence* — only species will have it...

The 'cloak' — i.e., the white man — here in *Met* VII (Z) 4 is like a whole family of similar examples. We can ask Aristotle's same questions about 'the masked man' in *Sophistical Refutations* 24, the musical man and the unmusical man in *Physics* A7, 'Socrates sitting' in *De Caelo* I.12. What is being 'the masked man', 'the musical man', 'the sitting man'? Is being any of these an essence at all? Aristotle scholars have fun with these kinds of things. Code (1976) calls them 'ephemeral objects' and describes them as Aristotelian 'space-time worms' (p. 182). Frank Lewis (1982) calls them 'accidental compounds'. Gary Matthews (1982) calls them 'kooky objects'. I use Matthews' term and call them all kooky objects. A kooky object is a concrete individual substance together with at least one accident that is true of it.

Consider the musical man. Suppose we use

☺ to mark out 'man', the underlying substance
♭ to mark out 'unmusical', an accidental attribute of a man, and
♯ to mark out musical, another accidental attribute, and
t_1 to t_6 to mark out particular times:

t_1	t_2	t_3	t_4	t_5	t_6
♭	♯	♯	♯	♯	♭
☺	☺	☺	☺	☺	☺

In Aristotle's language the accidental attributes 'musical' and 'unmusical' each 'coincide' with 'man', just not at the same time.[10] There is the unmusical man at t_1. When the unmusical man becomes musical at t_2, then the unmusical perishes. And later at t_6, say, when the man becomes tone deaf, the musical perishes, but the (unmusical) man remains.

When in *Met* VII (Z) 4 'cloak' is used to mean white man, then it, too, is a kooky object. In all of these there is a concrete individual substance — a man — who certainly has an essence. But there is nothing in Aristotle's metaphysics whose essence is to be white, or masked, or musical, or sitting. Certainly Aristotle claims that it is not the white man's essence to

[10] As Williams (1985, p. 78–9) explains, this use of 'coincides' is "the logical coincidence" of Aristotelian *per accidens* predication.

be white. He does not allow any sense in which the white man is *necessarily* white. Aristotle frequently makes the point that there is no science of accidents. For example, in *Metaphysics* VI (E) 2, he explains: "we must first say regarding the *accidental*, that there can be no scientific treatment of it. ... no science — practical, productive, or theoretical — troubles itself about it." Kooky objects exist, but they are only accidentally what they are, in the sense that the white man *coincides* with the man, who *does* have an essence. But the kooky object does not have an essence *itself*, since it is only an accidental sort of being. So there can be no science of kooky objects. When we introduce kooky objects into our modal syllogizing, they can generate wrong results. Aristotle notices this and deals with it. He carefully restricts his modal logic in order to rule out certain kinds of premises about such things. Here is what I mean. Consider the syllogistic schema known as Barbara XQM, which Aristotle describes in *An Pr* 34a34–b2:

(22) Barbara XQM
Every B is A
Every C is possibly-B
Every C is possibly-A

In (22) 'possibly' in the premise must be understood in the Q sense, while in the conclusion it is understood in the M sense. (Aristotle is explicit about this at *AnPr* 33b28–33.)

Aristotle tells us that Barbara XQM valid. But it looks invalid, as the following counterexample indicates:

(23)	Everything in the paddock is a horse	T
(24)	Every man could be in the paddock	T
(25)	Every man could be a horse	F

This is valid neither *de re* nor *de dicto*. So, has Aristotle made a mistake about the validity of Barbara XQM? A number of scholars have thought so, myself included. Some want to excise the passage.[11] Some say Aristotle's discussion and this counter-example in particular indicate an explicit rejection of Barbara XQM — that is, they interpret Aristotle as, here, giving a proof that Barbara XQM is *invalid* and not strictly a syllogism.[12] Some have

[11] For example, Patterson (1996). See pages 166–176, and especially page 174.

[12] See Tredennick (1938).

accused Aristotle of 'an horrendous mistake'.[13] But there is no mistake here. To see why, let's first look closely at Aristotle's explanation of the validity of Barbara XQM. It is a reductio proof and I have numbered Aristotle's steps.

> *Prior Analytics*, 34a34–b2:
> Now, with these determinations made, (i) let A belong to every B and (ii) let it be possible for B to belong to every C. Then (iii) it is necessary for it to be possible for A to belong to every C. (iv) For let it not be possible, and (v) put B as belonging to every C (this is false although not impossible). Therefore, if (iv) it is not possible for A to belong to every C and (v) B belongs to every C, then (vi) it will not be possible for A to belong to every B (for a deduction comes about through the third figure). But it was assumed that it is possible for A to belong to every B. Therefore, it is necessary for it to be possible for A to belong to every C (for when something false but not impossible was supposed, the result is impossible).

(i)	Every B is A	(23)	Everything in the paddock is a horse
(ii)	Every C is possibly-B	(24)	Every man could be in the paddock
(iii)	Every C is possibly-A	(25)	Every man could be a horse

Suppose

(iv)	Some C is not possibly-A	Some man could not be a horse
(v)	Every C is B	Every man is in the paddock

Then

(vi)	Some B is not possibly-A	Something in the paddock could not be a horse

(iv) is the reductio hypothesis. The move from (ii) to (v) is explained by a principle which Aristotle stipulated earlier in *An Pr* 34a25–27: '... when something false but not impossible is assumed, then what results through that assumption will also be false but not impossible.' So given the truth of (ii) — every C is possibly-B — we can suppose the possibility is realized. That is, we can suppose (v) — Every C is B. But of course there is a problem with this. Realizing the possibility in (ii) gets us (v) every man is in the paddock, and that changes the truth value of our premise (i) everything in the paddock is a horse. Once we realize the possibility in (ii) and generate (v),

[13] See Judson (1983) for an account of a similar difficulty in *De Caelo* I.12, and see Rini (2003) for an attempt to link the logic of *De Caelo* with Barbara XQM in *An Pr* I.15.

then (i) is no longer true. So the reductio proof cannot go through. Aristotle, however, thinks Barbara XQM is valid. Here is how Aristotle explains what has gone wrong:

> *An Pr* 34b7–18
> One must take 'belonging to every' without limiting it with respect to time (μὴ κατὰ χρόνον), e.g., 'now' or 'at this time', but rather without qualification (ἁπλῶς). For it is also by means of these sorts of premises that we produce deductions, since there will not be a deduction if the premise is taken as holding only at a moment (κατὰ τὸ νῦν). For perhaps nothing prevents man from belonging to everything in motion at some time (for example, if nothing else should be moving), and it is possible for moving to belong to every horse, but yet it is not possible for man to belong to any horse. Next, let the first term be animal, the middle term moving, the last term man. The premises will be in the same relationship, then, but the conclusion will be necessary not possible (for a man is of necessity an animal). It is evident, then, that the universal should be taken as holding without qualification, and not as determined with respect to time.

Aristotle gives counter-examples of his own, and the first of his works just like our counter-example (23)(24)(25), above:

All moving things are men	T
<u>All horses are possibly moving</u>	T
All horses are possibly men	F

Since Aristotle wants Barbara XQM to come out valid, he wants a way to *avoid* counter-examples, and to this end he recommends that we choose premises better: we need to restrict our terms so that we are not trying to syllogize from premises that are not always true. The restriction Aristotle recommends is against choosing premises that hold only at a time. His own counter-example and our example (23)(24)(25) show what can happen to Barbara XQM when this restriction is overlooked. Of course this will mean that Barbara XQM is valid subject to appropriate restriction. In effect, the restriction is on the B term — since if the B term names an accident, then the AB premise (the non-modal premise) will be about mere happenstance. It will be a contingent fact. This is the case with the AB premise in each of the counter-examples — 'everything in the paddock is a horse' and 'all moving things are men' are true with respect to a time. 'Nothing prevents man from belonging to everything in motion at some time.'

We saw how Aristotle's proof of Barbara XQM involves the realization of the possibility in the BC premise. Realization takes us from 'every C is possibly B' to 'every C is B'. And this can change the truth value of the merely happenstance AB premise. If Aristotle wants to rule out happenstance premises, then one way to do that is to restrict the B term so that it does not name an accident. Consider an example where B is oak tree:

(26)	Every oak is a deciduous tree	T
(27)	Every acorn could be an oak	T
(28)	Every acorn could be a deciduous tree	T

(26)(27)(28) has the form of Barbara XQM, but the truth value of premise (26) is not subject to change. Realizing the possibility in premise (27) cannot alter the truth of (26) — it cannot because (26) is *not* a contingent fact. And this makes all the difference to the way the proof proceeds. When the B term is restricted in order to rule out terms that name accidents, then the reductio works just as Aristotle describes in *An Pr* 34a34–b2 — i.e., in the steps numbered (i)–(vi) above. A contradiction arises between (vi) and (i), so the original syllogism Barbara XQM (i)(ii)(iii) is valid.

Horses in the paddock and moving men are of course kooky objects. Aristotle's instruction to choose premises that are not restricted to truth at a time is an indication that he does not want such kooky objects as subjects in premises of modal syllogisms. Deciduous oak trees are not kooky, and that is why (26)(27)(28) is a valid syllogism in the form Barbara XQM.

Of course Quine choses his examples deliberately, and part of his aim is to cast doubt about the meaningfulness of *de re* predicates. The only way Quine can make sense of modality requires a *de dicto* analysis. As we have seen, Aristotle has the tools needed to make this same distinction. He has essentialism and he has kooky objects. So consider what happens when we take Quine's terms *in an Aristotelian frame of mind* and try to determine how to analyse each of Quine's separate predicates — 'mathematical', 'cyclist', 'two-legged', and 'rational'. Rationality is for Aristotle straightforwardly essential to man in such a way that the rational man is not a kooky object. He is like the deciduous oak. And rational (that is, the rational thing) is, therefore, an appropriate subject in Aristotle's scientific deductions.

It is less obvious what we ought to say about being two-legged. Since man is by nature two-legged, we might take two-legged to be just as straightforward as the predicate rational. But of course a man can lose a leg and still remain a man, and this is unlike losing his rationality — for in general we call someone who loses his rationality a man by courtesy only. These different analyses make Quine's example less perspicuous than we might like — the two-legged man might not be a kooky object, but the one-legged man

quite likely is kooky because being one-legged can only be accidental to him. If 'two-legged' is a term in a proposition such as 'some terrestrial animals are necessarily two-legged' or 'some two-legged things are necessarily terrestrial animals', then the two-legged thing is not a kooky object because the necessity must be understood *de re* and the subject must be an Aristotelian substance. The two-legged thing is appropriate as either the subject or predicate term.

How straightforward is the predicate 'cyclist'? If being a cyclist is like being musical, then the cyclist is kooky. That is, if being a cyclist is something that a man can become and can cease to be — if for example he can learn to ride a bicycle and can subsequently forget how to ride one — then 'the cycling man' is a kooky object. If so, then Aristotle will not allow it as the subject of a modal premise. The cyclist is ruled out as a subject term in just the same way that the things in the paddock in (23)(24)(25) are ruled out. And of course when the cycling thing is put in predicate position — as for example in 'Some man is a necessary cyclist' — then the *de re* proposition is false.

The mathematician will be like the musical in that both mathematical ability and musical ability would seem to be capacities which follow from a man's essence. Since musical man is kooky, it seems that mathematical man is kooky too. When our friend Barbie learns mathematics, then, surely, being mathematical is something added but is not her essence.

It might help to schematize these remarks.

	Kooky	Straight
the rational man	✗	✓
the two-legged man	✗	✓
the one-legged man	✓	✗
the cycling man	✓	✗
the mathematical man	✓	✗

The distinctions here seem to me to be well within Aristotle's usual methods. Quine, however, wants to know not about how the separate predicates hold of a thing but about the concrete individual who is *both* a mathematician and a cyclist. Can this individual be contingently two-legged but essentially rational, or necessarily two-legged but accidentally rational? To ask this in the context of Aristotle's discussion, we are in effect asking about the appropriateness of the terms Quine has chosen for his premises. Has Quine chosen his terms well?

Aristotle's modal premises are what are called categorical propositions, relating a simple subject term and a predicate term. In Aristotle's scheme Quine's cyclist and mathematician correspond to the predicates 'cycling' and 'mathematical' but neither of these is a good, clear candidate for a subject

term in a premise about necessity. Mathematicians and cyclists seem to be kooky objects and as such they do not provide genuine subject terms — explaining why is the burden of *An Pr* 34b7–18. This suggests that Aristotle's answer to Quine would likely turn on the choice or on the use of his terms. What we really want is to know what Aristotle's response would be to Quine's claim that mathematicians are not necessarily two-legged, and cyclists are not necessarily rational? One of the first things Aristotle might note is that Quine's argument depends upon several universal propositions about necessity:

(29) = (3) All mathematicians are necessarily rational
(30) = (4) All cyclists are necessarily two-legged
(31) No mathematician is necessarily two-legged
(32) No cyclist is necessarily rational

Second, two of Quine's propositions involve negation. So (31) and (32) are what Aristotle calls 'universal privatives'. If we suppose there is an individual who is *both* a mathematician and a cyclist, then we have a 'particular affirmative' premise:

(33) Some mathematician is a cyclist

(33) does not itself involve any modal qualifier. It is an ordinary non-modal or assertoric proposition. From these propositions (29)–(33) contradiction arises.

(29) All mathematicians are necessarily rational
(33) Some cyclist is a mathematician
(34) Some cyclist is necessarily rational [Darii LXL, *An Pr* 30a36–38]

(30) All cyclists are necessarily two-legged
(33) Some mathematician is a cyclist
(35) Some mathematician is necessarily two-legged [Darii LXL]

(34) contradicts (32); (35) contradicts (31). So Quine argues *de re* modals do not make sense. So Quine argues Aristotelian essentialism does not make sense. The only way Quine sees to take (29)–(32) is as *de dicto* propositions.

How then could Aristotle analyse Quine's universal propositions (29)–(32) and what effect is there on Quine's argument? Start with (31):

(31) No mathematician is necessarily two-legged

If there is something that is both a mathematician and a man (a human), and if being two-legged is essential to men, then there are necessarily-two-legged mathematicians. But in Quine's analysis (31) is supposed to be true. And, so, if it is true, then one cannot take 'two-legged' in (31) to mean two-legged in the sense that is essential to man. So in Quine's example the two-legged man must be an Aristotelian kooky object. 'Man' names the underlying substance, and 'two-legged' names a feature of the substance in the same way that an ordinary accidental predicate names a feature of the substance. But is 'two-legged' then an accident of man? In Aristotle's usual usage it is not an accident, but as Quine is using it, it is, which is why in Quine's example a two-legged man is kooky. Quine's example is about a specific group of men, namely mathematicians, and the mathematical man as we have already noted is a kooky object. This means that *both* subject and predicate in (31) name kooky objects.

Next, let's reconsider (32):

(32) No cyclist is necessarily rational

Quine supposes that (32) is obviously true. But if there is something that is both a cyclist and a man, and if being rational is essential to men, then there are necessarily-rational cyclists. If (32) is true one cannot take 'rational' in (32) to mean rational in the sense that is essential to man. This makes (32) seem to work like (31). Quine takes 'rational' — i.e., what for Aristotle is an obvious example of an essential property of man — and uses it as though it is an accidental property. As Quine uses the predicates, the rational man is a kooky object. And so too is the cycling man. (32), like (31), involves both a subject and a predicate which name kooky objects.

What then is going on in Quine's argument? To get Quine's argument to work, all four predicates must be kooky. But Quine knows that 'rational' and 'two-legged' in their usual sense are not kooky, and he is trading on that in his argument. Quine cannot make sense of the view that properties can apply by necessity to things independently of how they are described. For Quine the only possible candidate for modal truth would be like the *de dicto* truth that every white man is white. But then, as we saw in the discussion of (7) and (8) above, Quine's argument fails. The closest Aristotle comes to a *de dicto* analysis is to tell us that 'white man is white indeed.' Aristotle is aware of some connection, but he shows that he is not prepared to allow that it is any kind of necessity. Aristotle allows that the white man is necessarily a man insofar as he is necessarily anything. But he does not extend this analysis to say that the white man is necessarily white. Instead, Aristotle's

analysis makes 'white man' a kooky object, and while Quine will interpret 'every white man is white' as a proposition about *de dicto* necessity, for Aristotle there is no *modal* notion involved. We might explain the difference in terms of analyticity. Even though Quine came to reject analyticity he still thought that it was the only hope for accounting for modality. Then the point is that Aristotle does not have any reason to think of necessity in terms of analyticity, and so the only kind of modality that Quine can countenance is something that Aristotle does not even think of as modality. So the only thing for Quine to do is to disown modality altogether.

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