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RAMSEY'S *RAMSEY-SENTENCES*[*]

1. CONTEXT AND AIMS

Frank Ramsey's posthumously published *Theories* has become one of the classics of the 20th century philosophy of science. The paper was written in 1929 and was first published in 1931, in a collection of Ramsey's papers edited by Richard Braithwaite. *Theories* was mostly ignored until the 1950s, though Ramsey's reputation was growing fast, especially in relation to his work on the foundations of mathematics. Braithwaite made *some* use of it in his *Scientific Explanation*, which appeared in 1953. It was Carl Hempel's *The Theoretician's Dilemma*, published in 1958, which paid Ramsey's paper its philosophical dues. Hempel coined the now famous expression 'Ramsey-sentence'.

When Rudolf Carnap read a draft of Hempel's piece in 1956, he realised that he had recently *re-invented* Ramsey-sentences. Indeed, Carnap had developed an "existentialised" form of scientific theory. In the protocol of a conference in Los Angeles, organised by Herbert Feigl in 1955, Carnap is reported to have extended the results obtained by William Craig to "type theory, (involving introducing theoretical terms as auxiliary constants standing for existentially generalised functional variables in 'long' sentences containing only observational terms as true constants)" (Feigl Archive, 04-172-02, 14). I have told this philosophical story in some detail elsewhere (1999, chapter 3). I have also discussed Carnap's use of Ramsey-sentences and its problems (see my 1999 chapter 3; 2000a; 2000b).

In the present paper I want to do two things. First, I want to discuss Ramsey's own views of Ramsey-sentences. This, it seems to me, is an important issue not just because of its historical interest. It has a deep philosophical significance. Addressing it will enable us to see what Ramsey's lasting contribution to the philosophy of science was as well as its relevance to today's problems. Since the 1950s, when the interest in Ramsey's views mushroomed, there have been a number of different ways to read Ramsey's views and to reconstruct Ramsey's project. The second aim of the present paper is to discuss the most significant and controversial of these reconstructions, i.e., structuralism. After some discussion of the problems of structuralism in the philosophy of science, as this was exemplified in Bertrand Russell's and Grover Maxwell's views and has reappeared in Elie Zahar's and John Worrall's thought, I will argue that, for good

M. C. Galavotti (ed.), Cambridge and Vienna: Frank P. Ramsey and the Vienna Circle, 67–90.

reasons, Ramsey did not see his Ramsey-sentences as part of some sort of structuralist programme. I will close with an image of scientific theories that Ramsey might have found congenial. I will call it *Ramseyan humility*.[1]

2. RAMSEY'S *THEORIES*

Theories is a deep and dense paper. There is very little in it by way of stage-setting. Ramsey's views are presented in a compact way and are not contrasted with, or compared to, other views. In this section, I will offer a brief presentation of the main argumentative strategy of *Theories*.[2]

Ramsey's starting point is that theories are meant to explain facts, those that can be captured within a "primary system" (1931, p. 212). As an approximation, we can think of it as the set of all singular observational facts and laws. The "secondary system" is the theoretical construction; that part of the theory which is meant to explain the primary system. It is a set of axioms and a "dictionary", that is "a series of definitions of the functions of the primary system (…) in terms of those of the secondary system" (1931, p. 215). So conceived, theories entail general propositions of the primary system ("laws"), as well as singular statements, ("consequences"), given suitable initial conditions. The "totality" of these laws and consequences is what "our theory asserts to be true" (ibid.).

This is a pretty standard hypothetico-deductive account of theories. Ramsey then goes on to raise three philosophical questions. Here are the first two:

(1) Can we say anything in the language of this theory that we could not say without it? (1931, p. 219)

(2) Can we reproduce the structure of our theory by means of explicit definitions within the primary system? (1931, p. 220)

The answer to the first question is *negative* (cf. 1931, p. 219). The secondary system can be eliminated in the sense that one could simply choose to stick to the primary system without devising a secondary system in the first place. The answer to the second question is *positive* (cf. 1931, p. 229). But Ramsey is careful to note that this business of explicit definitions is not very straightforward. They are indeed *possible*, but only if one does not care about the complexity or arbitrariness of these definitions. The joint message of Ramsey's answers is that theories need *not* be seen as having excess content over their primary systems.

These answers point to two different ways in which this broadly anti-realist line can be developed. The first points to an eliminative instrumentalist way, pretty much like the one associated with the implementation of theories of Craig's theorem. Theoretical expressions are eliminated *en masse* syntactically and hence the problem of their significance does not arise. The second points to a reductive empiricist way, pretty much like the one associated with the early work of the Logical Empiricists – before their semantic liberalisation. Theoretical

expressions are not eliminated; nor do they become meaningless. Yet, they are admitted at no extra ontological cost.

So far, Ramsey has shown that the standard hypothetico-deductive view of theories is *consistent* with certain anti-realist attitudes towards their theoretical part. He then raises a third question:

(3) [Are explicit definitions] necessary for the legitimate use of the theory? (1931, p. 229)

This is a crucial question. If the answer is positive, then some form of anti-realism will be mandatory: the necessary bedfellow of the hypothetico-deductive view. But Ramsey's answer is negative: "To this the answer seems clear that it cannot be necessary, or a theory would be no use at all" (1931, p. 230). Ramsey offers an important *methodological* argument against explicit definitions. A theory of meaning based on explicit definitions does not do justice to the fact that theoretical concepts in science are open-ended: they are capable of applying to new situations. In order to accommodate this feature, one should adopt a more flexible theory of meaning, in particular, a theory which is consistent with the fact that a term can be meaningfully applied to new situations *without* a change of meaning (cf. 1931, p. 230).

The important corollary of the third answer is that hypothetico-deductivism is also *consistent* with the view that theories have *excess content* over their primary systems. So the possibility of some form of *realism* is open. It is significant that Ramsey arrived at this conclusion by a methodological argument: the legitimate use of theories makes explicit definitions unnecessary. The next issue then is what this excess content consists of. That is, what is it that one can be a realist about?[3] This, I suggest, is the problem that motivates Ramsey when he writes:

The best way to write our theory seems to be this $(\exists \alpha, \beta, \gamma) :$ dictionary $\cdot$ axioms (1931, p. 231).

Ramsey introduces this idea with a fourth question:

(4) Taking it then that explicit definitions are not necessary, how are we to explain the functioning of the theory without them?

Here is his reply:

Clearly in such a theory judgement is involved, and the judgement in question could be given by the laws and consequences, the theory being simply a language in which they are clothed, and which we can use without working out the laws and consequences (1931, p. 231).

Judgements have content: they can be assessed in terms of truth and falsity. Theories express judgements and hence they can be assessed in terms of truth and falsity. Now, note the *could* in the above quotation. It is not there by accident, I suggest. Ramsey admits that the content of theory *could* be equated

with the content of its primary system. Since the latter is truth-evaluable, it can express a judgement. But this is *not* the only way. There is also the way ("the best way") he suggests: write the theory with existential quantifiers in the front.

3. EXISTENTIAL JUDGEMENTS

Ramsey's observation is simple but critical: the excess content of the theory is seen when the theory is formulated as expressing an existential judgement. In his *Causal Qualities*, Ramsey wrote: "I think perhaps it is true that the theory of general and existential judgements is the clue to everything" (1931, p. 261). In his *Mathematical Logic*, he (1931, p. 67ff.) spent quite some time criticising Weyl's and Hilbert's views of existential claims. Both of them, though for different reasons, took it that existential claims do not express judgements. Being an intuitionist, Weyl took it that existential claims are meaningless *unless* we possess a method of constructing one of their instances. Hilbert, on the other hand, took them to be ideal constructions which, involving as they do the notion of an infinite logical sum, are meaningless. Ramsey subjected both views to severe criticism. Its thrust is that existential propositions can, and occasionally do, express *all* that one does, or might ever be able to, know about a situation. This, Ramsey said, is typical in mathematics, as well as in science and in ordinary life. As he says: "(…) it might be sufficient to know that there is a bull somewhere in a certain field, and there may be no further advantage in knowing that it is this bull and here in the field, instead of merely a bull somewhere" (1931, p. 73).

Ramsey criticised Hilbert's programme in mathematics sharply because he did not agree with the idea that mathematics was symbol-manipulation. He did not deny that Hilbert's programme was *partly* true, but stressed that this could not be the "whole truth" about mathematics (1931, p. 68). He was even more critical of an extension of Hilbert's programme concerning "knowledge in general" (that is, to scientific theories as well) (cf. 1931, p. 71). As we have seen, Ramsey took theories to be meaningful existential constructions (judgements), which could be evaluated in terms of truth and falsity.

The extension of Hilbert's programme to apply to science had been attempted by Moritz Schlick (1918/1925, pp. 33-4). He saw theories as formal deductive systems, where the axioms implicitly define the basic concepts. He thought implicit definitions divorce the theory from reality altogether: theories "float freely"; "none of the concepts that occur in the theory designate anything real (…)" (1918/1925, p. 37). Consequently, he accepted the view that the "construction of a strict deductive science has only the significance of a game with symbols" (ibid.). Schlick was partly wrong, of course. An implicit definition is a kind of *indefinite description*: it defines a whole class of objects which can realise the formal structure, as defined by a set of axioms. Schlick did not see this very clearly. But he did encounter a problem. Theories express judgements; judgements designate facts (1918/1925, p. 42); a true judgement designates a set of

facts *uniquely* (1918/1925, p. 60); but the implicit definitions fail to designate anything uniquely; so a theory, if seen as a network of implicit definitions of concepts, fails to have any factual content. This is an intolerable consequence. Schlick thought that it is avoided at the point of application of the theory to reality. This application was taken to be partly a matter of observations and partly a matter of convention (cf. 1918/1925, p. 71).

In his (1932), he came back to this view and called it the geometrisation of physics:

> by disregarding the meaning of the symbols we can change the concepts into variables, and the result is a system of propositional functions which represent the pure structure of science, leaving out its content, separating it altogether from reality (1932, p. 330).

Seen in this structuralist light, the predicate letters and other constants that feature in the axioms should really be taken to be *genuine* variables. What matters is not the meaning of these non-logical constants, but rather the deductive – hence structural – relations among them. Scientific theories are then presented as logical structures, logical implication being the generating relation. The hypothetical part comes in when we ask how, if at all, this system relates to the world. Schlick's answer is that when one presents a theory, one makes a hypothetical claim: *if* there are entities in the world which satisfy the axioms of the theory, then the theory describes these entities (cf. 1932, p. 330-1).

Against the backdrop of Schlick's approach, we can now see Ramsey's insight clearly. We need not divorce the theory from its content, nor restrict it to whatever can be said within the primary system, *provided* that we treat a theory as an existential judgement. Like Schlick, Ramsey does treat the propositional functions of the secondary system as variables. But, in opposition to Schlick, he thinks that advocating an empirical theory carries with it a claim of *realisation* (and not just an if-then claim): *there are* entities which satisfy the theory. This is captured by the existential quantifiers with which the theory is prefixed. They turn the axiom-system from a set of open formulas into a set of *sentences*. Being a set of sentences, the resulting construction is truth-valuable. It carries the commitment that not all statements such as 'α, β, γ stand to the elements of the primary system in the relations specified by the dictionary and the axioms' are false. But of course, this ineliminable general commitment does not imply any *specific* commitment to the values of α, β, γ. (This last point is not entirely accurate, I think. But because it's crucial to see in what sense it is inaccurate, I shall discuss it in some detail in section 7).

4. RAMSEY-SENTENCES

As the issue is currently seen, in order to get the Ramsey-sentence ^{R}TC of a (finitely axiomatisable) theory TC, we conjoin the axioms of TC in a single sentence, replace all theoretical predicates with distinct variables u_i, and then

bind these variables by placing an equal number of existential quantifiers $\exists u_i$ in front of the resulting formula. Suppose that the theory TC is represented as TC $(t_1,...,t_n; o_1,...,o_m)$, where TC is a purely logical m+n-predicate. The Ramsey-sentence ^{R}TC of TC is: $\exists u_1 \exists u_2 ... \exists u_n$TC $(u_1,...,u_n; o_1,...,o_m)$. For simplicity let us say that the T-terms of TC form an n-tuple $t=<t_1,...,t_n>$, and the O-terms of TC form an m-tuple $o=<o_1,...,o_m>$. Then, ^{R}TC takes the more convenient form: $\exists u$TC(u,o).

I will follow customary usage and call Ramsey's existential-judgements Ramsey-sentences. This is, I think, partly misleading. I don't think Ramsey thought of these existential judgements as *replacements* of existing theories or as capturing their *proper* content (as if there were an *improper* content, which was dispensable). Be that as it may, Ramsey-sentences have a number of important properties. Here they are:

^{R}TC is a logical consequence of TC.

^{R}TC mirrors the deductive structure of TC.

^{R}TC has exactly the same first-order observational consequences as TC. So ^{R}TC is empirically adequate iff TC is empirically adequate.

TC_1 and TC_2 have incompatible observational consequences iff $^RTC_1$ and $^RTC_2$ are incompatible (Rozeboom 1960, p. 371).

TC_1 and TC_2 may make incompatible *theoretical* assertions and yet $^RTC_1$ and $^RTC_2$ be compatible (cf. English 1973, p. 458).

If $^RTC_1$ and $^RTC_2$ are compatible with the same observational truths, then they are compatible with each other (cf. English 1973, p. 460; Demopoulos 2003a, p. 380).

Let me sum up Ramsey's insights. First, a theory need *not* be seen as a summary of what can be said in the primary system. Second, theories, *qua* hypothetico-deductive structures, have excess content over their primary systems, and this excess content is seen when the theory is formulated as expressing an existential judgement. Third, a theory need *not* use names in order to refer to anything (in the secondary system). Existentially bound variables can do this job perfectly well.[4,5] Fourth, a theory need *not* be a definite description to be a) truth-valuable, b) ontically committing, and c) useful. So uniqueness of realisation (or satisfaction) is not necessary for the above. Fifth, if we take a theory as a *dynamic* entity (something that can be improved upon, refined, modified, changed, enlarged), we are better off if we see it as a *growing existential sentence*. This last point is particularly important for two reasons.

The first is this. A typical case of scientific reasoning occurs when two theories TC_1 and TC_2 are conjoined (TC_1 & TC_2=TC) in order to account for some phenomena. But if we take their Ramsey-sentences, then $\exists u TC_1(u, o)$ and $\exists u TC_2(u, o)$, they do not entail $\exists u$TC(u, o). Ramsey was aware of this problem. He solved it by taking scientific theories to be growing existential sentences. That is to say, the theory is already in the form $\exists u$TC(u, o) and all further addi-

tions to it are done *within* the scope of the original quantifiers. To illustrate the point, Ramsey uses the metaphor of a fairy tale. Theories tell stories about the form: "Once upon a time there were entities such that ...". When these stories are modified, or when new assertions are added, they concern the original entities, and hence they take place *within* the scope of the original "once upon a time".

The second reason is this: Ramsey never said that the distinction between primary and secondary system was static and fixed. So there is nothing to prevent us from replacing an existentially bound variable by a name or by a constant (thereby moving it into the primary system), if we come to believe that we know what its value is. His *Causal Qualities* is, in a sense, a sequel to his *Theories*. There, Ramsey characterises the secondary system as "fictitious" and gives the impression that its interest lies in its being a mere systematiser of the content of the primary system. But he ends the paper by saying this:

> Of course, causal, fictitious, or 'occult' qualities may cease to be so as science progresses. E.g., heat, the fictitious cause of certain phenomena (…) is discovered to consist of the motion of small particles. So perhaps with bacteria and Mendelian characters or genes. This means, of course, that in later theory these parametric functions are replaced by functions of the given system (1931, p. 262).

In effect, Ramsey says that there is no principled distinction between fictitious and non-fictitious qualities. If we view the theory as a growing existential sentence, then this point can be accommodated in the following way. As our knowledge of the world grows, the propositional functions that expressed 'fictitious' qualities (and were replaced by existentially bound variables) might well be taken to characterise known quantities and hence be re-introduced in the growing theory as names (or constants).[6]

Viewing theories as existential judgements solves another problem that Ramsey faced. He did not see causal laws (what he called "variable hypotheticals") as proper propositions. As he famously stated: "Variable hypotheticals are not judgements but rules for judging 'If I meet a ϕ, I shall regard it as a ψ'" (1931, p. 241). Yet, he also took the secondary system to comprise variable hypotheticals (cf. 1931, p. 260). Taking the theory as an existential judgement allows Ramsey to show how the theory as a whole can express a judgement, though the variable hypotheticals it consists of, if taken in *isolation* from the theory, do *not* express judgements. The corollary of this is a certain wholism of meaning. The existential quantifiers render the hypothetico-deductive structure truth-valuable, but the consequence is that no 'proposition' of this structure has meaning apart from the structure.[7]

5. RUSSELL'S STRUCTURALISM

In this section, I want to examine the link, if any, between Russell's structuralism and Ramsey's existential view of theories. This issue has been discussed quite extensively and has given rise to the view called 'structural realism'.

In *The Analysis of Matter*, Russell aimed to reconcile the abstract character of modern physics, and of the knowledge of the world that this offers, with the fact that all evidence there is for its truth comes from experience. To this end, he advanced a *structuralist* account of our knowledge of the world. According to this, only the structure, i.e., the totality of formal, logico-mathematical properties, of the external world can be known, while all of its intrinsic properties are inherently unknown. This logico-mathematical structure, he argued, can be legitimately *inferred* from the structure of the perceived phenomena (the world of percepts) (cf. 1927, pp. 226-7). Indeed, what is striking about Russell's view is this claim to *inferential knowledge* of the structure of the world (of the stimuli), since the latter can be shown to be *isomorphic* to the structure of the percepts. He was quite clear on this:

> (...) whenever we infer from perceptions, it is only structure that we can validly infer; and structure is what can be expressed by mathematical logic, which includes mathematics (1927, p. 254).

Russell capitalised on the notion of structural similarity he himself had earlier introduced. Two structures M and M' are isomorphic iff there is an 1-1 mapping f (a *bijection)* of the domain of M onto the domain of M' such that for any relation R in M there is a relation R' in M' such that $R(x_1 \ldots x_n)$ iff $R'(fx_1 \ldots fx_n)$. A structure ("relation-number") is then characterised by means of its isomorphism class. Two isomorphic structures have identical logical properties (cf. 1927, p. 251).

How is Russell's inference possible? Russell relied on the causal theory of perception: physical objects are the causes of perceptions.[8] This gives him the *first* assumption that he needs, i.e., that there are physical objects which cause perceptions. Russell used two more assumptions. The *second* is what I (2001) have called the 'Helmholtz-Weyl' principle, i.e., that different percepts are caused by different physical stimuli (cf. 1927, p. 226, p. 252, p. 400). Hence, to each type of percept there corresponds a type of stimuli. The *third* assumption is a principle of "spatio-temporal continuity" (that the cause is spatio-temporally continuous with the effect). From these Russell concluded that we can have "a great deal of knowledge as to the *structure* of stimuli". This knowledge is that

> there is a roughly one-one relation between stimulus and percepts, [which] enables us to infer certain mathematical properties of the stimulus when we know the percept, and conversely enables us to infer the percept when we know these mathematical properties of the stimulus (1927, p. 227).

The "intrinsic character" of the stimuli (i.e., the nature of the causes) will remain unknown. The structural isomorphism between the world of percepts and the world of stimuli isn't enough to reveal it. But, for Russell, this is just as well. For as he claims: "(...) nothing in physical science ever depends upon the actual qualities" (1927, p. 227). Still, he insists, we can know something about the structure of the world (cf. 1927, p. 254). Here is an example he uses: Suppose that we hear a series of notes of different pitches. The structure of stimuli that causes us to hear these notes must be such that it also forms a series "in respect to some character which corresponds causally with pitch" (1927, p. 227).

The three assumptions that Russell uses are already quite strong but, actually, something more is needed for the inference to go through. The establishment of isomorphism requires also the converse of the Helmholtz-Weyl principle – viz., different stimuli cause different percepts. Hence, to each type of stimuli there corresponds a type of percept. If the converse of the Helmholtz-Weyl principle is not assumed, then the isomorphism between the two structures cannot be *inferred*, for the required 1-1 correspondence between the domains of the two structures is not shown.[9]

The notion of structural similarity is purely logical and hence we need not assume any kind of (Kantian) intuitive knowledge of it. So an empiricist can legitimately appeal to it. It is equally obvious that the assumptions necessary to establish the structural similarity between the two structures are not logical but substantive. I am not going to question these assumptions here (see my 2001).[10] Let us grant them. An empiricist need *not* quarrel with them. Hence, since Russell's inference is legitimate from an empiricist perspective, its intended conclusion, viz., that the unperceived (or unobservable) world has a certain knowable structure, will be acceptable too. With it comes the idea that of the physical objects (the causes, the stimuli) we can only know their formal, logico-mathematical properties. This inference, as Russell says, "determines only certain logical properties of the stimuli" (1927, p. 253).

Russell's structuralism has met with a fatal objection, due to M.H.A. Newman (1928): the structuralist claim is *trivial* in the sense that it follows logically from the claim that a set can have *any* structure whatever, consistent with its cardinality. So the actual content of Russell's thesis, viz., that the structure of the physical world can be known, is exhausted by his first assumption, viz., by positing a set of physical objects with the right cardinality. The supposed extra substantive point, viz. that of *this* set it is also known that it has structure *W*, is wholly insubstantial. The set of objects that comprise the physical world cannot possibly fail to possess structure *W* because, if seen just as a set, it possesses *all* structures which are consistent with its cardinality. Intuitively, the elements of this set can be arranged in ordered n-tuples so that set exhibits structure *W*.[11] Newman sums this up by saying:

Hence the doctrine that *only* structure is known involves the doctrine that *nothing* can be known that is not logically deducible from the mere fact of existence, except ('theoretically') the number of constituting objects (1928, p. 144).

Newman's argument has an obvious corollary: the redundancy of the substantive and powerful assumptions that Russell used in his argument that the structure of the world can be known inferentially. These assumptions give the impression that there is a substantive proof available. But this is not so.

6. MAXWELL'S STRUCTURALISM

Russell's thesis was revamped by Maxwell – with a twist. Maxwell took the Ramsey-sentence to exemplify the proper structuralist commitments. He advanced "structural realism" as a form of representative realism, which suggests that i) scientific theories issue in existential commitments to unobservable entities and ii) all non-observational knowledge of unobservables is *structural knowledge*, i.e., knowledge not of their first-order (or intrinsic) properties, but rather of their higher-order (or structural) properties (cf. 1970a; 1970b). The key idea here is that a Ramsey-sentence satisfies both conditions (i) and (ii) above. If we know the Ramsey-sentence we know that there are properties that satisfy it (because of the existentially bound quantifiers), but of these properties we know only their "structural properties".

Maxwell's association of Russell's structuralism with Ramsey's views (cf. 1970b, p. 182) is, at least partly, wrong. To see this, recall that Russell's structuralism attempted to provide some *inferential* knowledge of the structure of the world: the structure of the world is isomorphic to the structure of the appearances. I think it obvious that Ramsey-sentences cannot offer this. The structure of the world, as depicted in a Ramsey-sentence, is not isomorphic to, nor can it be inferred from, the structure of the phenomena which the Ramsey-sentence accommodates. Now, the distinctive feature of the Ramsey-sentence ^{R}TC of a theory TC is that it preserves the logical *structure* of the original theory. We may say then that when one accepts ^{R}TC, one is committed to a) the observable consequences of the original theory TC; b) a certain logico-mathematical structure in which (descriptions of) the observable phenomena are deduced; and c) certain abstract existential claims to the effect that there are (non-empty classes of) entities which satisfy the (non-observational part of the) deductive structure of the theory. In this sense, we might say that the Ramsey-sentence, if true, gives us knowledge of the structure of the world: *there is a certain structure which satisfies the Ramsey-sentence and the structure of the world (or of the relevant worldly domain) is isomorphic to this structure*.[12] I suppose this is what Maxwell really wanted to stress when he brought together Russell and Ramsey.

The problem with Maxwell's move is that it falls prey to a Newman-type objection. The existential claim italicised above follows logically from the fact that the Ramsey-sentence is empirically adequate, subject to certain cardinality

constraints. In other words, subject to cardinality constraints, if the Ramsey-sentence is empirically adequate, it is true. The proof of this has been given in different versions by several people.[13] Its thrust is this: Take ^{R}TC to be the Ramsey-sentence of theory TC. Suppose ^{R}TC is empirically adequate. Since ^{R}TC is consistent, it has a model. Call it *M*. Take *W* to be the 'intended' model of TC and assume that the cardinality of *M* is equal to the cardinality of *W*. Since ^{R}TC is empirically adequate, the observational sub-model of *M* will be identical to the observational sub-model of *W*. That is, both the theory TC and its Ramsey-sentence ^{R}TC will 'save the (same) phenomena'. Now, since *M* and *W* have the same cardinality, we can construct an 1-1 correspondence *f* between the domains of *M* and *W* and *define* relations *R'* in *W* such that for any theoretical relation *R* in *M*, $R(x_1 \ldots x_n)$ iff $R'(fx_1 \ldots fx_n)$. We have induced a structure-preserving mapping of *M* on to *W*; hence, *M* and *W* are isomorphic and *W* becomes a model of ^{R}TC.

Another way to see the problem is to look at Carnap's assimilation of Ramsey's sentences (see my 2000a). Carnap noted that a theory TC is logically equivalent to the following conjunction: ^{R}TC & (^{R}TC→TC), where the conditional ^{R}TC→TC says that *if* there is some class of entities that satisfy the Ramsey-sentence, *then* the theoretical terms of the theory denote the members of this class. For Carnap, the Ramsey-sentence of the theory captured its factual content, and the conditional ^{R}TC→TC captured its analytic content (it is a *meaning postulate*). This is so because the conditional ^{R}TC→TC has no factual content: its own Ramsey-sentence, which would express its factual content if it had any, is logically true. As Winnie (1970, p. 294) observed, under the assumption that ^{R}TC→TC – which is known as the Carnap sentence – is a meaning postulate, it follows that ^{R}TC←→TC, i.e., that the theory is equivalent to its Ramsey-sentence.[14] In practice, this means that the Carnap sentence poses a certain restriction on the class of models that satisfy the theory: it excludes from it all models in which the Carnap-sentence fails. In particular, the models that are excluded are exactly those in which the Ramsey-sentence is true but the theory false. So if the Ramsey-sentence is true, the theory must be true: it cannot *fail* to be true. Is there a sense in which ^{R}TC can be false? Of course, a Ramsey-sentence may be empirically inadequate. Then it is false. But if it *is* empirically adequate (if, that is, the structure of observable phenomena is embedded in one of its models), then it is bound to be true. For, as we have seen, given some cardinality constraints, it is guaranteed that there is an interpretation of the variables of ^{R}TC in the theory's intended domain.

We can see why this result might not have bothered Carnap. If being empirically adequate is enough for a theory to be true, then there is no extra issue of the truth of the theory to be reckoned with – apart of course of positing an extra domain of entities. Empiricism can thus accommodate the claim that theories are true, without going a lot beyond empirical adequacy.[15] Indeed, as I have argued elsewhere (1999 chapter 3, 2000a), Carnap took this a step further. In his own account of Ramsey-sentences, he deflated the issue of the possible existential commitment to physical unobservable entities by taking the existentially bound

Ramsey-variables to extend beyond mathematical entities. Of the Ramsey-sentences he said:

> the observable events in the world are such that there are numbers, classes of such etc., which are correlated with the events in a prescribed way and which have among themselves certain relations; and this assertion is clearly a factual statement about the world (1963, p. 963).

Carnap's thought, surely, was not that the values of the variable are *literally* numbers, classes of them etc. How possibly can a number be correlated with an observable event? Rather, his thought was that a) the use of Ramsey-sentences does *not* commit someone to the existence of *physical* unobservable entities (let alone, to for instance, electrons in particular); and b) the things that matter are the observable consequences of the Ramsey-sentence, its logical form, and its abstract claim of realisation.

Let me grant that this equation of truth with empirical adequacy is quite acceptable for an empiricist, though I should say in passing that it reduces much of science to nonsense and trivialises the search for truth.[16] But reducing truth to empirical adequacy *is* a problem for those who want to be realists, even if just about structure. For, it is no longer clear what has been left for someone to be a realist about. Perhaps, the structural realist will insist that the range of the Ramsey-variables comprises *unobservable* entities and properties. It's not clear what the reason for this assertion is. What is it, in other words, that excludes all other interpretations of the range of Ramsey-variables?

But let's assume that, somehow, the range of Ramsey-variables is physical unobservable entities. It might be thought that, consistently with structuralism, the excess content of theories is given in the form of *non-formal* structural properties of the unobservables. Maxwell, for instance, didn't take all of the so-called structural properties to be purely formal (cf. 1970b, p. 188). In his (1970a, p. 17), he took "temporal succession, simultaneity, and causal connection" to be among the structural properties. But his argument for this is hardly conclusive: "for it is by virtue of them that the unobservables interact with one another and with observables and, thus, that Ramsey sentences have observable consequences". Hearing this, Ramsey would have raised his eyebrow. In *Theories*, he had noted: "This causation is, of course, in the second system and must be laid out in the theory" (1931, p. 235).[17] The point, of course, is that we are in need of an independent argument for classifying some relations, e.g., causation, as 'structural' and hence as knowable.

When it comes to causation, in particular, a number of issues need to be dealt with. First, what are its structural properties? Is causation irreflexive? Not if causation is persistence. Is causation asymmetric? Not if there is backward causation. Is causation transitive? Perhaps yes – but even this can be denied (in the case of probabilistic causation, for instance). Second, suppose that the structural properties of causation are irreflexivity, asymmetry and transitivity. If these properties constitute *all* that can be known of the relevant relation, what is there

to distinguish causation from another relation with the same formal properties, e.g., a relation of temporal ordering? Third, even if causation were a non-formal structural relation, why should it be the case that only its structural properties could be known?

Note a certain irony here. Suppose that since causation is a relation among events in the primary system, one assumes that it is the same relation that holds between unobservable events and between unobservable and observable events. This seems to be Maxwell's view above. Now, causal knowledge in the primary system (that is causal knowledge concerning observables) is not purely structural. The (intrinsic) properties of events (or objects) by virtue of which they are causally related to one another are knowable. If causation is the very same relation irrespective of whether the relata are observable or unobservable, why should one assume that the (intrinsic) properties of unobservable events (or objects) by virtue of which they are causally related to one another are *not* knowable? There seems to be no ground for this asymmetry. In both cases, it may be argued, it is by virtue of their (intrinsic) properties that entities are causally related to each other. In both cases, it might be added, causal relations supervene on (or are determined by) the intrinsic properties of observable or unobservable entities.[18] Indeed, these last points are fully consistent with Russell's (and Maxwell's) views. Recall that according to the causal theory of perception, which Maxwell also endorses, our percepts are causally *affected* by the external objects (the stimuli, the causes), which must be in virtue of these objects' intrinsic properties. (Surely, it is *not* by their formal properties.) The Helmholtz-Weyl principle (that different percepts are caused by different stimuli) implies that the different stimuli must differ in their *intrinsic* properties. So the latter are causally active and their causal activity is manifested in the different percepts they cause. In what sense then are they unknowable?[19]

The general point is that Maxwell's Ramsey-sentence approach to structuralism faces a sticky dilemma. Either there is nothing left to be known except *formal* properties of the unobservable and observable properties or there are some knowable non-formal properties of the unobservable. In the former case, the Ramsey-sentence leaves it (almost) entirely open what we are talking about. In the latter case, we know a lot more about what the Ramsey-sentence refers to, but we thereby abandon pure structuralism.

7. WORRALL AND ZAHAR'S STRUCTURALISM

The points raised in the last section are particularly relevant to the Zahar-Worrall (2001) view that adopting the Ramsey-sentence of the theory is *enough* to be a realist about this theory. Indeed, they are aware of the problems raised so far. They do deal with Putnam's model-theoretic argument against realism and admit that if this argument is cogent, then the Ramsey-sentence of a(n) (epistemically ideal) theory is true. Note that a theory's being epistemically ideal includes its

being empirically adequate. But it's not hard to see that Putnam's argument is a version of the Newman challenge.[20] Zahar and Worrall (2001, p. 248) ask: "should the structural realist be worried about these results?" And they answer: "(…) the answer is decidedly negative". So Zahar and Worrall do accept the equation of the truth of the theory with the truth of its Ramsey-sentence. In fact, they want to capitalise on this in order to claim that truth is achievable. They claim that two *seemingly* incompatible empirically adequate theories will have compatible Ramsey-sentences and hence they can both be true of the world (cf. 2001, pp. 248-9).

We have already seen the price that needs to be paid for truth being achievable this way: truth is a priori ascertainable, given empirical adequacy and cardinality. But it is interesting to note that Zahar and Worrall are not entirely happy with this equation. They carry on to stress that "the more demanding structural realist" can say a bit more. He (they?) can distinguish between different empirically adequate Ramsey-sentences using the usual theoretical virtues (simplicity, unification etc.), opt for the one that better exemplifies these virtues (e.g., it is more unified than the other) and claim that it is *this one* that should be taken "to reflect – if only approximately – the real structure of W [the world]" (2001, p. 249). But I doubt that this, otherwise sensible, strategy will work in this case. For one, given that the theoretical virtues are meant to capture the explanatory power of a theory, it is not clear in what sense the truth of the Ramsey-sentence *explains* anything. If its truth is the same as its empirical adequacy, then the former cannot explain the latter. Further, there is something even more puzzling in the Zahar-Worrall claim. If two theories have compatible Ramsey-sentences, and if truth reduces to empirical adequacy, in what sense can the theoretical virtues help us deem one theory true and the other false? Clearly, there could be a straightforward sense, if truth and empirical adequacy were distinct. But this is exactly what the Zahar-Worrall line denies. Could they simply say that there is a sense in which one Ramsey-sentence is *truer* than the other? They could, but only if the truth of the theory answered to something different from its empirical adequacy. If, for instance, it was claimed that a theory is true if, on top of its being empirically adequate, it captures the natural structure of the world, then it is clear that a) one theory can be empirically adequate and yet false; and b) one of two empirically adequate theories can be truer than the other.[21]

Now, there could be another sense in which an appeal to the theoretical virtues could distinguish between the claim that a theory is *true* and the claim that its Ramsey-sentence is empirically adequate. This is by conceptually equating truth with empirical adequacy *plus* the theoretical virtues. If this equation went ahead, then someone could claim that a theory could be empirically adequate and false, if the theory lacked in theoretical virtues. Or, someone could claim that among two empirically adequate theories, one was truer than the other if the first had more theoretical virtues than the second; or if the first fared better vis-à-vis the theoretical virtues than the second. But these claims would amount to an endorsement of an *epistemic account of truth*. In particular, they would amount

to forging an a priori (conceptual) link between the truth of the theory and its possession of theoretical virtues. I will not criticise this move now. Suffice it to say that such a move has disputed realist credentials. So it is not open to those who want to be realists.[22]

In his reply to Russell's structuralism, Newman pointed to a way in which Russell's claim would *not* be trivial, viz., if the relation that generated the required structure *W* was "definite", that is if we knew (or claimed that we knew) *more* about what it is than that it exists and has certain formal properties. Couldn't we distinguish between "important" and "unimportant" relations and stay within structuralism? Not really. The whole point is precisely that the notion of an 'important relation' cannot be part of a purely structuralist understanding. Newman saw this point very clearly (see 1928, p. 147). In order to pick as important one among the many relations which generate the same structure on a domain, we have to go beyond structure and talk about *what* these relations are, and *why* some of them are more important than others.

It's not hard to see that the very same objection can be raised against a Maxwell- or a Zahar-Worrall structural realism. And it is equally obvious what the remedy could be. Structural realists should have a richer understanding of the relations that structure the world. Suppose there is indeed some definite relation (or a network, thereof) that generates the structure of the world. If this is the case, then the claim that the structure *W* of the physical world is isomorphic to the structure *W′* that satisfies an empirically adequate Ramsey-sentence would be far from trivial. It would require, and follow from, a comparison of the structures of two independently given relations, say *R* and *R′*. But structural realists as well as Russell *deny* any independent characterisation of the relation *R* that generates the structure of the physical world. On the contrary, structural realists and Russell insist that we can get at this relation *R* only by knowing the structure of another relation *R′*, which is deemed isomorphic to *R*. We saw that the existence of *R* (and hence of *W*) follows logically from some fact about cardinality.

It goes without saying that treating these relations as "definite" would amount to an abandonment (or a strong modification) of structuralism.[23] The natural suggestion here is that among all those relations-in-extension which generate the same structure, only those which express *real relations* should be considered. But specifying which relations are real requires knowing something *beyond* structure, viz., which extensions are 'natural', i.e., which subsets of the power set of the domain of discourse correspond to natural properties and relations. Having specified these natural relations, one may abstract away their content and study their structure. But if one begins with the structure, then one is in no position to tell *which* relations one studies and *whether* they are natural or not.

8. RAMSEY AND NEWMAN'S PROBLEM

As noted above, Ramsey's crucial observation was that the excess content of the theory is seen when the theory is formulated as expressing an existential judgement. If, on top of that, Ramsey meant to assert something akin to the structural realist position, i.e., that this excess content, so far as it is knowable, is purely *structural*, then he would have landed squarely on the Newman problem. So should this view be attributed to Ramsey?

Before I canvass a negative answer, let me go back to Russell once more. Russell (1927) took theories to be hypothetico-deductive systems and raised the issue of their interpretation. Among the many "different sets of objects [that] are abstractly available as fulfilling the hypotheses", he distinguished those that offer an "important" interpretation (1927, pp. 4-5), that is an interpretation which connects the theory (as an abstract logico-mathematical system) to the empirical world. This was important, he thought, because all the evidence there is for physics comes from perceptions. He then went on to raise the central question that was meant to occupy the body of his book: when are physical theories *true*? As he (1927, pp. 8-9) put it, there is a wider sense in which physics is true:

> Given physics as a deductive system, derived from certain hypotheses as to undefined terms, do there exist particulars, or logical structures composed of particulars, which satisfy these hypotheses?

"If", he added, "the answer is in the affirmative, then physics is completely 'true'". Actually, he took it that his subsequent structuralist account, based on the causal theory of perception, was meant to answer the above question affirmatively. Now, Russell's view has an obvious similarity to Ramsey's: theories as hypothetico-deductive structures should be committed to an existential claim that *there is* an interpretation of them. But there is an interesting dissimilarity between Russell and Ramsey. Russell thought that *some* interpretation was important (or more important than others), whereas Ramsey was not committed to this view. Russell might well identify the theory with a *definite description*: there is a unique (important) interpretation such that the axioms of the theory are true of it. But, as we have seen, one of Ramsey's insights is that there is no reason to think of theories as *definite* descriptions – i.e., as requiring uniqueness.

It seems likely that it was this Russellian question that inspired Ramsey to formulate his own view of theories as existential judgements. In fact, there is some evidence for it. In a note on Russell's *The Analysis of Matter*, Ramsey (1991, p. 251) said:

> Physics says = is true if ($\exists$ α, β, … R, S): F(α, β, … R, S…) (1).

He immediately added a reference – "Russell p. 8" – to *The Analysis of Matter*.[24]

(1) looks very much like a Ramsey-sentence. But unlike Russell, Ramsey did *not* adopt a structuralist view of the content of theories. This may be seen by what he goes on to say: the propositional functions α and *R* should be "nonformal". And he adds: "Further, *F* must not be tautological as it is on Eddington's view". As it is clear from another note (1991, pp. 246-50), Ramsey refers to Eddington's *The Nature of the Physical World*. In his review of this book, Braithwaite criticised Eddington severely for trying to turn physics "from an inductive science to a branch of mathematics" (1929, p. 427). According to Braithwaite, Eddington tried to show how the laws of physics reduce to mathematical identities, which are derivable from very general mathematical assumptions. This must be wrong, Braithwaite thought, for in mathematics "we never know what we are talking about", whereas in physics "we do know (or assume we know) something of what we are talking about – that the relata have certain properties and relations – without which knowledge we should have no reason for asserting the field laws (even without reference to observed quantities)" (1929, p. 428). The point might not be as clear as it ought to have been, but, in effect, Braithwaite argued against Eddington that natural science would be trivialised if it was taken to aim at achieving only knowledge of structure.[25]

I don't know whether Ramsey discussed Eddington's book with Braithwaite or whether he had read Braithwaite's review of it (though he *had* read Eddington's book – see 1991, pp. 246-50). It is nonetheless plausible to say that he shared Braithwaite's view when he said of the relation *F* that generates the structure of a theory that it should not be tautological "as it is on Eddington's view". In fact, in the very same note, Ramsey claims that in order to fix some interpretation of the theory we need "some restrictions on the interpretation of the other variables. i.e., all we know about β, S is not that they satisfy (1)".

So I don't think Ramsey thought that viewing theories as existential judgements entailed that only structure (plus propositions of the primary system) could be known. It's plausible to argue that Ramsey took Ramsey-sentences (in *his* sense) to require the existence of *definite* relations, whose nature might not be *fully* determined, but which is nonetheless constrained by some theoretical and observational properties. To judge the plausibility of this interpretation, let's look into some of his other papers.

In *The Foundations of Mathematics*, Ramsey insisted on the distinction between classes and relations-in-extension, on the one hand, and real or actual properties and relations, on the other. The former are identified extensionally, either as classes of objects or as ordered n-tuples of objects. The latter are identified by means of predicates. Ramsey agreed that an extensional understanding of classes and relations is necessary for mathematics. Take, for instance, Cantor's concept of class-similarity. Two classes are similar (that is, they have the same cardinality) iff there is an one-one correspondence (relation) between their domains. This relation, Ramsey (1931, p. 15) says, is a relation-in-extension: there needn't be any actual (or real) relation correlating the two classes. The class of male angels may have the same cardinality with the class of female

angels, so that the two classes can be paired off completely, without there being some real relation ("such as marriage") correlating them (1931, p. 23). But this is not all there is to relations. For it may well be the case that two classes have the same cardinality because there is a "real relation or function *f(x, y)* correlating them term by term" (ibid.). He took it that the real propositional functions are determined "by a description of their senses or imports" (1931, p. 37). In fact, he thought that appealing to the meaning of propositional functions is particularly important when we want to talk of functions of functions (Ramsey's $f(\phi x)$), that is (higher-level) propositional functions f whose values are other propositional functions (ϕx). He wrote: "The problem is ultimately to fix as values of $f(\phi x)$ some definite set of propositions so that we can assert their logical sum or product" (1931, p. 37). And he took it that the best way to determine the range of the values of $f(\phi x)$ is to appeal to the meanings of the lower-level propositional functions (ϕx) (1931, pp. 36-7).

Recall Ramsey's Ramsey-sentence $(\exists \alpha, \beta, \gamma) : dictionary \cdot axioms$. The open formula $dictionary \cdot axioms (\alpha, \beta, \gamma)$ is a higher-level propositional function, whereas the values of α, β, γ are lower-level propositional functions. The Ramsey-sentence itself expresses the logical sum of the propositions that result when specific values are given to α, β, γ. This situation is exactly analogous to the one discussed by Ramsey above. So, it's plausible to think that the values of α, β, γ are some *definite* properties and relations. That is, they are not *any* class or relation-in-extension that can be defined on the domain of discourse of the Ramsey-sentence.

This point can be reinforced if we look at Ramsey's *Universals*. Among other things, Ramsey argues that the extensional character of mathematics "is responsible for that great muddle the theory of universals", because it has tended to obscure the important distinction between those propositional functions that are names and those that are incomplete symbols (cf. 1931, pp. 130-1 & p. 134). The mathematical logician is interested only in classes and relations-in-extension. The difference between names and incomplete symbols won't be reflected in any difference in the classes they define. So the mathematician disregards this difference, though, as Ramsey says, it is "all important to philosophy" (1931, p. 131). The fact that some functions cannot stand alone (that is, they are incomplete symbols) does not mean that "all cannot" (ibid.). Ramsey takes it that propositional functions that are names might well name "qualities" of individuals (cf. 1931, p. 132). Now, Ramsey puts this idea to use in his famous argument that there is no difference between particulars and universals.[26] But the point relevant to our discussion is that propositional functions can be names.

Given a) Ramsey's view that the propositional functions of physics should be non-formal, b) his insistence on real or actual properties and relations, and c) his view that at least *some* relations can be named by propositional functions, it seems plausible to think that he took the variables of *his* Ramsey-sentence to extend beyond *real properties and relations* – some of which could be named. I am not aware of a passage in his writings which says *explicitly* that the variables

of the Ramsey-sentence extend beyond real or actual properties and relations. But his contrasting of mathematics (in which the variables are purely extensional) to science suggests that he might well have taken the view described above. Now, the other claim, i.e., that some of the Ramsey-variables can be names, also follows from his view, seen in section 4, that some propositional functions can give way to *names* of properties, as science grows.

If I am right, the Newman challenge cannot be raised against Ramsey's views. Ramsey takes theories to imply the existence of definite (or real) relations and properties. Hence, it's no longer trivial (in the sense explained above) that if the theory is empirically adequate, it is true. His Ramsey-sentences can be seen as saying that there are *real properties and relations* such that …. Note that, in line with Ramsey's denial of a distinction between universals and particulars, the existentially bound variables should be taken to quantify over properties and relations in a metaphysically non-committal way: they quantify over properties and relations which are not universals in the traditional sense, which renders them fundamentally different from particulars.[27]

The corollary is that Ramsey's views cannot be described as *pure* structuralism. The claim that there are real properties and relations is not structural because, to say the least, it specifies the *types* of structure that one is interested in. Besides, Ramsey does not claim that only the structure (or the structural properties) of these relations can be known. Well, it might. Or it might not. This is certainly a contingent matter.

If my interpretation is right, I have a hurdle to jump. It comes from Ramsey's comment on "the best way to write our theory". He says: "Here it is evident that α, β, γ are to be taken purely extensionally. Their extensions may be filled with intensions or not, but this is irrelevant to what can be deduced in the primary system" (1931, p. 231). But this comment is consistent with my reading of his views. The propositional variables may range over real properties and relations, but when it comes to what can be *deduced* in the primary system, what matters is that they are of a certain logical type, which the Ramsey-sentence preserves anyway. Indeed, deduction cuts through content and that's why it is important. In any case, the comment above would block my interpretation only if what really mattered for theories was what could be deduced in the primary system. I have already said enough, I hope, to suggest that this view was *not* Ramsey's.

9. RAMSEYAN HUMILITY

Let me end by sketching an image of scientific theories to which the above interpretation of Ramsey's Ramsey-sentences might conform. As already noted, I call it *Ramseyan humility*.

We treat our theory of the world as a *growing existential statement*. We do that because we want our theory to express a judgement: to be truth-valuable. In writing the theory, we commit ourselves to the existence of things that make our

theory true and, in particular, to the existence of unobservable things that cause or explain the observable phenomena. We don't *have to* do this. But we think we are better off doing it, for theoretical, methodological and practical reasons. So we are *bold*. Our boldness extends a bit more. We take the world to have a certain structure (to have *natural joints*). We have independent reasons to think of it, but in any case, we want to make our theory's claim to truth or falsity substantive. The theoretical superstructure of our theory is not just an idle wheel. We don't want our theory to be true just in case it is empirically adequate. We want the structure of the world to act as an *external constraint* on the truth or falsity of our theory. So we posit the existence of a natural structure of the world (with its natural properties and relations). We come to realise that this move is *not* optional once we have made the first bold step of positing a domain of unobservable entities. These entities are powerless without properties and relations, and the substantive truth of our theories requires that these are real (or natural) properties and relations.[28]

That's, more or less, where our boldness ends. We don't want to push our (epistemic) luck too hard. We want to be *humble* too. We don't foreclose the possibility that our theory might not be uniquely realised. So we don't require uniqueness: we don't turn our growing existential statement into a definite description. In a sense, if we did, we would no longer consider it as growing. We allow a certain amount of indeterminacy and hope that it will narrow down as we progress. Equally, we don't foreclose the possibility that what the things (properties) we posited are might not be found out. Some things (properties) must exist if our theory is to be true and these things (properties) must have a natural structure if this truth is substantive. Humility teaches us that there are many ways in which these commitments can be spelled out. It also teaches us that, in the end, we might not be lucky. We don't, however, draw a sharp and principled distinction between what can and what cannot be known. We are not lured into thinking that *only* the structure of the unobservable world can be known, or that only the structural properties of the entities we posited are knowable or that we are cognitively shut off from their intrinsic properties. These, we claim, are imposed epistemic dichotomies on perfect epistemic continua.

We are reflective beings after all, and realise that dichotomous claims such as the above need independent argument to be plausible. We read Kant, we read Russell, Schlick, Maxwell, Redhead and Lewis, but we have not yet been persuaded that there is a sound independent argument for pushing humility too far (though we admit that we have been shaken). So we choose to be open-minded about this issue. The sole arbiter we admit is our give-and-take with the world.

A further sign of our humility, however, is that we treat what appear to be *names* of theoretical entities as variables. We refer to their values indefinitely, but we are committed to their being *some* values that make the theory true. As science grows, and as we acquire some knowledge of the furniture of the world, we modify our growing existential statement. We are free to replace a variable with a name. We are free to add some new findings within our growing

existential statement. We thereby *change* our theory of the world, but we had anticipated this need. That's why we wrote the theory as a growing existential statement. We can bring continuity and change under the same roof. The continuity is secured by the bound Ramsey-variables and the change is accommodated by adding or deleting things within their scope.

In the meantime, we can accommodate substantial disagreement of two sorts. Scientific disagreement: what exactly are the entities posited? In fostering this kind of disagreement, we are still able to use the theory to draw testable predictions about the observable world. But we do not thereby treat the theoretical part of the theory simply as an aid to prediction. For, we have not conceded that all that can possibly be known of the entities posited is that they exist. We can also accommodate metaphysical disagreement: what is the metaphysical *status* of the entities posited? Are they classes? Universals? Tropes? Some kind of entity which is neutral? Still, in fostering this kind of disagreement, we have taken a metaphysical stance: whatever else these entities are, they should be natural.

To be conciliatory, I could describe Ramseyan humility as *modified structuralism*. Structuralism emerges as a humble philosophical thesis, which rests, however, on a bold assumption – without which it verges on vacuity – viz., that the world has a natural structure that acts as an external constraint on the truth or falsity of theories. I don't claim that the image sketched *is* Ramsey's. But he might have liked it. In any case, I take it that something like it is true. It's not attractive to someone who is not a realist of some sort. But it is flexible enough to accommodate realisms of all sorts.

NOTES

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1. The name was inspired by the title of Rae Langton's splendid book *Kantian Humility*. Langton's Kant was epistemically humble because he thought that the intrinsic properties of things-in-themselves were unknowable. I am not claiming that Ramsey was humble in the same way. After I presented this paper in Vienna, D H Mellor told me that there was an unpublished paper by the late David Lewis with the title "Ramseyan Humility". Stephanie Lewis has kindly provided me with a copy of it. Langton's book is obviously the common source for Lewis's and my *Ramseyan Humility*. But Lewis's *Ramseyan Humility* is different, stronger and more interesting, than mine.
2. Still the best overall account of Ramsey's philosophy of science is Sahlin's (1990, chapter 5).
3. Here, I disagree with Sahlin's view that Ramsey was an instrumentalist.
4. As he says, in a slightly different context, "though I *cannot* name particular things of such kinds I can think of there being such things" (1991, p.193).

5. This is a point made famous by Quine. As he put it: "Variables can be thought of as ambiguous names of their values. This notion of ambiguous names is not as mysterious as it first appears, for it is essentially the notion of a pronoun; the variable 'x' is a relative pronoun used in connection with a quantifier '(x)' or '(∃x)'. Here, then, are five ways of saying the same thing: 'There is such a thing as appendicitis' (…) 'The word 'appendicitis' is a name' (…) 'The disease appendicitis is a value of a variable' (…)" (quoted by Alex Orenstein (2002, pp.25-6).
6. Compare what Ramsey says of the blind man who is about to see: "part of his future thinking lies in his present secondary system" (1931, p.261).
7. One of Carnap's lasting, if neglected, contributions in this area is his use of Hilbert's ε-operator as a means to restore some form of semantic atomism compatible with Ramsey-sentences. See my (2000b) for details.
8. This is an inductively established assumption, as Russell took pains to explain (cf. 1927, chapter 20).
9. Russell agonises a lot about this. He knows that the relation between percepts and stimuli is one-many and not one-one. See (1927, pp.255-6).
10. See also Mark Sainsbury's excellent (1979, pp.200-11).
11. More formally, we need a theorem from second-order logic: that every set *A* determines a *full* structure, i.e., one which contains all subsets of *A*, and hence every relation-in-extension on *A*. For an elegant and informative presentation of all the relevant proofs, see Ketland (2004).
12. This is not, however, *generally* true. For every theory has a Ramsey-sentence and there are cases of theories whose Ramsey-sentence does not give the isomorphism-class of the models that satisfy the theory. This has been recently highlighted by Demopoulos (2003b, pp.395-6). For some relevant technical results, see van Benthem (1978, p.324 & p.329).
13. Winnie (1967, pp.226-227); Demopoulos & Friedman (1985); Demopoulos (2003a, p.387); Ketland (2004).
14. In a joint paper (see appendix IV of Zahar 2001, p.243), Zahar and Worrall call the Carnap-sentence "metaphysical" because it is untestable. What they mean is actually equivalent to what Carnap thought, viz., that the Carnap-sentence has no factual content. They may well disagree with Carnap that it is a meaning postulate. Be that as it may, the Carnap-sentence is *part* of the content of the original theory TC. So Zahar and Worrall are not entitled to simply excise it from the theory on the grounds that it is metaphysical. The claim that the variables of the Ramsey-sentence range over physical unobservable entities is no less metaphysical and yet it is admitted as part of the *content* of the Ramsey-sentence.
15. This point is defended by Rozeboom (1960).
16. I am not saying that striving for empirical adequacy is a trivial aim. By no means. It is a very demanding – and perhaps utopian – aim. What becomes trivial is searching for truth over and above empirical adequacy, since the former comes for free, if the latter holds.
17. For some similar thoughts, see Russell (1927, pp.216-7).
18. This, however, is what Langton's Kant *denies*. See her (1998).
19. This whole issue has been haunted by a claim made by Russell, Schlick, Maxwell and others that intrinsic properties should be directly perceived, intuited, picturable etc. I see no motivation for this, at least any more. Note that this is *not* Lewis's motivation for the thesis that the intrinsic properties of substances are unknowable. For Lewis's reasons see his "Ramseyan Humility". For a more detailed defence of the claim that pure structuralism cannot accommodate causation, see my 'The Structure, the Whole Structure and Nothing but the Structure?', presented at the Austin PSA meeting in November 2004. http://philsci-archive.pitt.edu/archive/00002068
20. For more on this, see Demopoulos 2003a.
21. Maxwell (1970a; 1970b) as well as Zahar and Worrall (2001) take Ramsey to have argued that the knowledge of the unobservable is knowledge by description as opposed to knowledge by acquaintance. This, as we have seen, is true. But note that though they go on to argue that this knowledge is purely structural, and that the intrinsic properties of the unobservable are unknowable, this further thesis is independent of the descriptivist claim. So, it requires an *independent* argument. It is perfectly consistent for someone to think that the unobservable is knowable only by means of descriptions and that this knowledge describes its intrinsic properties as well. For an excellent descriptivist account of Ramsey-sentences, see David Papineau (1996).
22. For more on this see my "Scientific Realism and Metaphysics" (2005).

23. A similar point has been made by Demopoulos (2003b, p.398). It is also made by James van Cleve (1999, p.157), who has an excellent discussion of how the problem we have discussed appears in Kant, and in particular in an interpretation of Kant's thought as imposing an isomorphism between the structure of the phenomena and the structure of the noumena.
24. In some notes on theories that Ramsey made in August 1929, he seems not to have yet the idea of the theory as an existential judgement. He writes: "We simply say our primary system can be consistently constructed as part of a wider scheme of the following kind. Here follows dictionary, laws, axioms etc." (1991, p.229).
25. Braithwaite came back to this issue in a critical notice of Eddington's *The Philosophy of Physical Science*. He (1940) argued against Eddington's structuralism based on Newman's point against Russell. He noted characteristically: "If Newman's conclusive criticism had received proper attention from philosophers, less nonsense would have been written during the last twelve years on the epistemological virtue of pure structure" (1940, p.463). Eddington replied in his (1941). For a critical discussion of this exchange, see Solomon (1989).
26. Propositional functions can name objects no less than ordinary names, which are normally the subjects of propositions. Hence, ultimately, Ramsey denies *any* substantive distinction between individuals and qualities: "all we are talking about is two different types of objects, such that two objects, one of each type, could be sole constituents of an atomic fact" (1931, p.132). These two types of objects are "symmetrical" and there is no point in calling one of them *qualities* and the other *individuals*.
27. This might address worries that the Ramsey-sentence involves second-order quantification. For more on this, see Sahlin (1990, p.157).
28. I think this is the central message of Lewis (1984) devastating critique of Putnam's model-theoretic argument against realism

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