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Ron Hoeflin has forwarded an inquiry from one member about dues, and informed me in his own accompanying letter about an upcoming article by George Dicks concerning Newcomb's paradox. This piece will appear in the next issue. To whatever extent it bears on previous contributions, I will add commentary.

It has long been insisted by those trying to guard the "purity" of science that no insight ever be pursued beyond the barrier that separates science from the paranormal. This insistence implies the untenable assumption that ultimate models of reality can be confined entirely to the "daylight" side of this barrier, a thesis which presumes the ultimacy of the accepting syntax common to individual human beings. This, as we have seen, is the epistemological equivalent of the ancient doctrine which held that because men inhabit the earth, the earth must be the absolute center of the universe. This prehistoric viewpoint directly opposes the objectivity it is supposed to promote, rendering the intellects of its partisans highly suspect.

Yet, many of these partisans show every sign of being quite rational in their understanding of narrower concerns. This anomaly implies the involvement of emotions like fear and dislike, especially of those who exploit human gullibility on pretexts they know to be false. The world is full of charlatans and fast-buck artists for whom the limits on human induction double as limits on their personal honesty; it is unsurprising that many of us are less than willing to issue them *carte blanche* in their depredations. But when the point arrives at which holding the line against them cannot be done without sacrificing our ability to explain actual phenomena like correlations of quantum polarization, it is time to stop leaning against the doors of perception. If a fraud or two slips through, we can at least ensure that "undecidable" phenomena remain within the light of logical analysis, and thus in the hands of responsible interpreters.

As members are aware, we have been led into quantum theory by way of a study in "scientific demonology": the logical analysis of hypothetical creatures able to manifest paranormal and nonlocal effects within the physical world. The field of demonology has a long, if less than distinguished, history. This is not surprising: in Noesis 46, we constructed a headhunter/explorer analogy to show that the formulation of inexplicable phenomena often begins on a metaphysical level, particularly among primitive and prescientific observers (natural phenomena, such as comets, eclipses, plagues, droughts, and crop failures, have often served in place of strange visitors). While the demon concept may have a phenomenal aspect - given its basis in the computative limitations of its adherents - it has been colorfully embellished by virtually all of the various cultures in which it has arisen. Some of these embellishments are well documented, including those in the western Judeo-Christian tradition.

Among western demonologists, it was once fashionable - indeed, *de rigueur* - to name and rank demons in hellish hierarchies defining a kind of supernatural "pecking order". This, presumably, was to allow sorcerers and magicians to call on the demons appropriate to their purposes, as well as tell exorcists which demons were so strong that they should be avoided by all but the most righteous challengers. Such hierarchies - in addition to giving identifying characteristics and specialties - could naturally be used by any handicapper wanting to pit one demon against another, or to call battles among sorcerers according to the demons whose services each had enlisted. The *Peterson Field Guides* of the scaley and winged, such writings alerted students of the netherworld to the distinctive markings and habits of hell's major denizens. But this was not their only use. *Demonologie,* by King James VI of Scotland - later to become James I of England - was published in support of witch hunting, and became a best seller of its day.

The bibliography of a demonic handicapper might easily contain titles as diverse as the ancient Hebrew *Testaments of the Twelve Patriarchs, The War of the Sons of Light and the Sons of Darkness* (one of the Dead Sea Scrolls), the *Testament of Solomon* (from the early Christian era), a long list of magical texts with titles like *Ars Magica, Grimorium Verum, Lemegeton,* and *Grand Grimoire,* and even *Paradise Lost.* A typical hierarchy might go something like: "Lucifer, Satan, Beelzebub, Astaroth, Beherith, Asmodeus, Belial..." Each demon had his own cornermen, and the pecking order could to some extent change by author. The demons themselves were also subject to evolution: e.g., the first three just listed have come to be regarded as one predominant evil entity. And Astaroth, a male demon, seems to have evolved from Ashtart, identified with Ishtar as a Middle Eastern mother goddess, by way of Astarte, once identified with the Greek love goddess Aphrodite.

In keeping with this long tradition, Ron Hoeflin proposes that demonic conflict be subjected to logical analysis in the CTMU context. Not only would this at last settle in a rational, impartial way the matter of who can take whom, but - more importantly - it would weigh on the question of *omniscience,* which relates to Γ in a way similar to that of omnipotence. As readers will recall, this latter issue was dealt with in a recent issue of Noesis, in which we showed how easily theism withstands criticisms based upon it. As we might therefore expect, criticisms based on omniscience fare no better against the CTMU ultimate depiction of reality.

The apposite portion of the first of Mr. Hoeflin's two letters reads as follows. "I do have one new argument that I'd like to pose. No doubt this scenario has already been covered in principle by your theory as you believe my previous objections are covered. But just for the sake of argument, suppose that there are two or more demons who each appear to be able to predict my choices infallibly. What would happen if I ask two of these demons to play one another? Would they each be able to infallibly predict the other's choices, or is it possible for one of them to be a higher, more infallible demon than the other? It seems to me there may be a paradox here, but it is difficult for me to formulate it any better than by the foregoing question."

In fact, there are at least two paradoxes here. One arises from the supposition that two predictor-controller demons can infallibly predict each other's (purely independent) choices without being in collusion. If what we mean by "playing each other" is that the first demon D_1 has offered the second demon D_2 a Newcomb wager, or that each has offered the other a separate wager, the supposition in question generates a metagame scenario like that described in Noesis 45. This forces collectivisation of utility, implying formation of mutual deterministic behavioral programming.

Their purposes thus fused, both emerge victorious - provided that the subjective utility of each rationally self-interested demon is served by that which the other is offering. Of course, if one or both demons are self-destructive or insincere, the game-theoretic scenario becomes degenerate.

It may happen that one demon is dominant. Domination implies containment of the spatiotemporal range of control of the weaker demon in that of the stronger, the "inclusion"-criterion mentioned in Noesis 44 (page 9, third paragraph). Note that the inclusion is essentially algorithmic; if the computative power and data-access of one demon exceeds that of the other, the lesser's algorithm can be simulated and dominated by that of the greater. While power and accessibility can be defined within strata, they also transect interdeterministic boundaries. Stratification thus corresponds to specific contexts; while Γ-stratification is global with respect to the accepting syntax presumed to be common to all human beings, it is generally relativized to particular automatonic syntaxes.

Let us suppose that the relationship of D_1 and D_2 is exactly analogous to that of ND and M_N. The paradox that arises now is identical to Newcomb's paradox. The resolution is also identical; since the deterministic accepting syntax of D_2 can be violated at will by D_1, the self-interest of D_2 compels him to fulfill that prediction of D_1 which would result in mutual advantage. Just as in Newcomb's paradox, the metagame scenario is now enforced by D_1-relativized confirmation of D_2-generated D_1-nonlocality. This also results in joint optimality; D_2's admission of the dominance of D_1 leads to the same outcome as mutual dominance. This would not hold true if the dominant demon were trying to do the dominee anything but a favor. The dominator wins regardless of intent, just as the sufficiently skilled programmer can win any such battle with his computer...even if that means crashing the system or hammering the machine into shrapnel. Of course, the irrational destructiveness of such a programmer would belie his alleged skill, rendering him a paradox within himself...resolvable only by recourse to a higher parametrization of rationality.

Notice that the same reasoning applies if "playing each other" means that the prize contested by the two demons is the heart and mind of M_N. Two mutually-predictive demons would be compelled to join forces, whereas a contest between two unequal demons is a winner-take-all proposition for the computative victor. The weaker demon might then find himself enslaved, or even the main course at an ectoplasmic lunch break. Certainly, if the weaker demon had any evidence of the superiority of his opponent, he would back out rather than risk being pressed into service as a cabin boy in the slave galley of an indomitable master, forever to ply the Lake of Fire amid the wailing souls of the damned.

On a less alarming note, the ability of one demon to transcend another is a corollary of Γ-regression. The ultimate extension of this regression would seem to be unlimited computative power, or "omniscience". Appropriately, Mr. Hoeflin followed up his first letter with another, which was accompanied by a photocopy from the February, 1990 issue of Proceedings of the American Philosophical Society. This contains an abstract of a paper entitled "On an Argument Against Omniscience" by one Keith Simmons concerning an argument attributed to one Patrick Grim. This argument purportedly derives the impossibility of omniscience from Cantor's power set theorem (presumably, this refers to Cantor's proof that no finite or infinite set N is equivalent to the set of all of its subsets:

$|N| < 2^{|N|}$). Since we lack the papers in question, we must beg the pardon of the authors and proceed from the abstract alone.

Simmons claims to refute Grim's thesis, and thus redeem the concept of omniscience, by invalidating the two distinct stages of Grim's argument. The first stage, which from Cantor's proof infers that there is no set of all truths, is answered with the Liar's Paradox. The second stage, which involves the assertion that Russell's paradox is unresolvable, is deemed unconvincing. Russell's paradox concerns the set of all sets which do not include themselves as elements: does this set include itself, or not? If it does, then it doesn't; and if it doesn't, then it must. The resolution of this paradox was undertaken by Russell and Whitehead in their monumental encryption of logicism, Principia Mathematica (to be distinguished from Isaac Newton's tome of the same name). This intended reduction of mathematics to logic treated Russell's paradox by means of a stratification of the syntax of set theory, known as the *theory of types*. One effect of this theory on the paradox is to limit the universal quantifier "all", which can let a function negate itself. Apparently, Grim has opposed himself to the titanic Russell by denying the validity of type theory...an opposition in which he may have been encouraged by Russell's own eventual part in the negative consensus on its efficacy.

Russell was motivated by the imperative for absolute certainty and total consistency in mathematics. He was driven to prove the ultimacy of the human (propositional) logical syntax and establish its freedom from paradox. He was the champion of human reason, a quixotic white knight who vowed to bring all of reality under the dominion of our regal intellects. Unfortunately, paradox is more than a nuisance; it is a necessary characteristic of any system expressively powerful enough to formulate its own global (syntactic) negation. When Gödel effectively demonstrated this in the context of arithmetic - a context, we should add, that in no way has a monopoly on the meaning of Gödel's theorems, but was chosen precisely for its generality (as well as its direct applicability to certain questions of current notoriety, e.g., whether it would ever be possible to derive a master algorithm for solution of all conceivable mathematical problems) - Russell became discouraged. This, after all, was poetic justice. Russell himself had used his own paradox to destroy the masterwork of Frege, his predecessor as claimant to the title of "champion", on the eve of publication of its second volume, and "Gödel's paradox" could not have made him feel any worse than Russell's paradox had made Frege feel!

Russell was discouraged in part by the work of the Austrian logician Kurt Gödel, who showed that any attempt to formulate a complete method of paradox resolution invites inconsistency, or further paradoxes. Yet, it can be shown that Gödel's method, which resembles the diagonal method by which Cantor proved the theorem mentioned above, leads to a regression essentially identical to that postulated by type theory. That is, the typic regression of logical functions corresponds to the inferential and truthwise regression of theories, which themselves consist of such functions interpreted over "semantical" object-domains. So Gödel's theorem amounts to a mere reformulation of the antinomies that type theory was designed to avoid, and an extended version of type theory can thus be applied to its supposed nemesis.

These perspectives, logicism and formalism, are complementary; though often characterized as antithetical, both of them - along with their joint complement, intuitionism - are parts of the same unified program for understanding the nature and objectives of cognition. They are but different perspectives on the single comprehensive model we have been exploring. On the other hand, those lacking knowledge of this model may be quite unqualified to engage in squabbles over its components. This can easily be determined with respect to the debate reported by Mr. Hoeflin, which appears to be neatly resolvable by a little common sense.

First, consider Cantor's theorem $|N| < 2^{|N|}$. In simple terms, this means that there are more ways to group the individual elements of a set that there are elements in that set; if one has two marbles colored red and blue, one can form the four subsets ⟨Φ⟩, ⟨r⟩, ⟨b⟩, and ⟨rb⟩. Similarly, if one has three marbles colored red, blue, and green, one can form the subsets ⟨Φ⟩, ⟨r⟩, ⟨b⟩, ⟨g⟩, ⟨rb⟩, ⟨rg⟩, ⟨bg⟩, and ⟨rbg⟩. This makes a total of $4 = 2^2$ and $8 = 2^3$ subsets for sets of two and three elements respectively. Since $2 < 4$ and $3 < 8$, Cantor's theorem is verified for sets of two and three elements. The proof can be extended to sets of any cardinality as follows: let the presence or absence of a particular element in a subset of an n-element set be represented by 1 or 0 respectively in the appropriate cell of an n-ary array. Then the variety of distinct contents of the array equals the total number of possible subsets. Since there are 2^n ways to fill such an array with ones and zeros, each way corresponding to a unique subset, there are 2^n subsets for the set. Since raising $n = |N|$ by one on the left side of Cantor's equation means multiplying the right side by two, the inequality is preserved up to infinity.

Now consider the set of all binary decimals consisting of arbitrary infinite strings of ones and zeros: .000..., .1000..., .01000..., .11000..., and so on. These numbers, which correspond to the point coordinates of a unit line segment, are considered as definite despite their infinite seriality. Let the set be arranged in the form of a list, and let the list be considered definite ("completed") in the same way as its elements. The list forms a square array with infinite sides. Now take the main diagonal of this array which runs from the first digit of the first entry to the last digit of the last entry; this is itself a binary decimal which must be somewhere in the "completed" list. "Diagonalize" it by applying logical negation to each of its digits, changing each digit (1 or 0) into its complement (0 or 1). The number so-formed differs from each number in the list in at least one digit (the digit at its intersection with the main diagonal), and is thus not in the list. But this contradicts the assumption that the list is complete. In other words, the assumption of completeness leads to inconsistency by way of logical negation on a global argument (in this case, the main diagonal of the array).

Cantor, who invented this proof, took it to mean that the denumerable (countable) infinity describing the size of the array is a lower kind of infinity than the indenumerable "continuum", which describes the unit line segment of which the array's elements are point coordinates. This is an inherently procedural distinction; the unbounded process of counting is of a lower order than that of motion through continuous spaces. This can be cast as a resolution of certain notorious paradoxes (e.g., those of Zeno) involving the necessary traversement by moving objects of infinite series of nonzero intervals in order to reach their destinations; this connection was initially noted by Russell in his book of lectures, *Our Knowledge of the External World.* The procedural nature of the resolution should be noted, for it bears strongly on the other part of Grim's argument.

Notice also the similarity of the relationship between completeness and consistency, as implicitly derived by Cantor, to that later derived explicitly by the Austrian logician Kurt Gödel. Both theorists described methods for constructing the logical negation of a system. But whereas Cantor used this negation merely to distinguish kinds of sets, Gödel went on to describe a method whereby to project this negation into the base system itself. This method, called *arithmetization* or *Gödelization,* is remarkably evocative of the coded relationship between the programmatic and output levels of automated computative systems. And, as we now recall, this similarity has been used to model the observational and theoretical aspects of science in terms of an ultimate computative system called the CTMU.

In the context of Cantorian transfinite arithmetic, note the interplay between *ordinality* and *cardinality.* These two ways of looking at integers reflect a numeric duality by which every positive integer is both a temporal or sequential marker in a linear "ordertype", and an autonomous predicate describing a class of sets by their number of elements. In the latter case, the number may be considered a descriptive "space" in which only certain sets are included. This *spatiotemporal duality* is a logical property of the number concept. Cantor relied implicitly on this duality when he translated "unbounded process", a compact expression of ordinal infinity, into its dual concept, the infinite cardinality of the transcendentally "completed set" generated by the infinite process. Morphisms between processes are thus mapped to correspondences between sets. Cantor's proof that $n < 2^n$ is notable for its bearing on procedural as well as arithmetical distinctions; the numeric inequality corresponds to a difference between the denumerative and continuous *ordertypes* (although not as usually cited; the standard denial of "one-to-one correspondence" must be reformulated in terms of a set of relative assumptions). Gödel used this duality when he applied his proof, which superficially deals with "arithmetical predicates" of cardinal numbers, to any system which evolves according to the principle of transfinite induction. The successive states of such a system can be given ordinal labels corresponding to their moments in time; they are "predicates" of the "cardinal" steps at which they occur.

Where we consider arrays of facts instead of numbers, these facts being syntactically formulated in some kind of linguistic format, "completeness" is equivalent to an exhaustive tabulation of facts. This approximates Gödel's conception of an axiomatic system; because of the compressive nature of theorization, diagonalization can be effected by statements about "indemonstrability" in the apposite format. Gödel created a "fact" not implicit in the initial "array" and projected it into the array itself, implying that the assumption of completeness is inconsistent with the diagonalistic prerogative. Observe, however, that the Cantorian tableau, which does not allow for any syntax more sophisticated than that required to count from one to denumerable infinity, is insufficient to Gödel's argument. This implies that Grim is trying to prove Gödel's theorem by extending the Cantorian tableau with Russell's paradox. One possible use of the paradox is to consider only syntactically correct and meaningful formulations, rather than indiscriminate strings of words or symbols analogous to Cantor's "binary decimals" (this is not an oxymoron, but refers to the decimal point initiating the binary string).

Let us simplify Russell's paradox by considering the set of all sets, irrespective of non-self-inclusion. This is not a stable mathematical object, but can be apprehended only as a temporal *process:* as soon as Russell's set becomes self-inclusive by some appropriate convolutive mechanism, we must reiterate the autology. Thus, the formulation defines a procedure, or active program, rather than a set. So if we are speaking of a set of all sets of facts or truths, we are speaking about a cognitive procedure. Where omniscience is defined on such a set, it is procedural; this procedure may be described as the "process of knowing". Now recall that Cantor's proof relied on the "completion" of nonterminating decimals and the process of counting or listing them. By this very reasoning, we can consider the omniscience process to be completed as well. So Cantor's proof, plus Russell's paradox, implies the existence of omniscience.

To put it another way, consider the hypothesis that Russell's paradox is unresolvable due to its definitional instability. This is to deny autologous (self-referential) processes, and therefore time itself! That is, time is computative iteration under varying parameters, and iteration a form of self-reference. If Russell's set cannot include itself in the computative sense, then neither can it "refer" to itself...nor can it or any other set or system evolve over time. Say, on the other hand, that Russell's paradox is unresolvable due to its potential infinity. Then no process can be infinite and complete, Gödel opposes and prevails over Cantor, and Grim loses the first part of his argument. Had Grim realized these implications, he might well have adjusted his position.

Gödelistic diagonalization of an exhaustive tabulation of facts creates either a nonfact, or a fact which is nondeterministic with respect to the inferential or observational procedure by which the table has been generated. Either factuality or determinacy is relativized to the base array, and diagonalistic formulae are either nonfactual or indeterminate within it. Let the base array contain all facts accessible to the common accepting syntax of human beings; these are the facts which are directly verifiable by us within reality as we know it. Being uninterested in nonfacts, we need consider only Γ_0-indeterminate truths. But the predicate "indeterminate" is relativized to our syntax, and may describe facts which obey a Γ_0-inaccessible set of deterministic principles (i.e., which are caused from outside our dynamic).

Accordingly, let the array contain all facts accessible by the master syntax Γ. Now "indeterminacy" is relativized to Γ, and any higher deterministic scheme to which such facts conform must characterize the *metasyntax* of (the syntax of) Γ. This relationship entails the logicomathematical definition of a constructive agency or medium by or within which Γ is reducible; this agency is the only possible vehicle of omniscience. To put it as succinctly as possible, *omniscience is the province of this agency.* While the wider meaning of "this agency" is to some extent obvious, we will continue to define it as a logical abstraction, as mathematically justifiable and inoffensive as any other definition we might require for explanative purposes. Note also that "construction" is equivalent to "cosmogeny" in this context, and that its denial (e.g., in favor of a "steady state" model of some kind) merely redirects diagonalistic nondeterminacy towards the open parameters of Γ - i.e., those state-parameters in which Γ-nondeterministic Γ_0-evolution in fact occurs.

Suppose - perhaps like Grim - that omniscience is impossible not just for humans with limited transductive syntaxes, but for all conceivable automata. This implies a diagonalistic regress beyond all stages of composition of Γ, terminating at an ultimate form of indeterminacy. But all this "ultimate indeterminacy" can do is replace "omniscience" in the above italicized expression: *ultimate indeterminacy is the province of this agency.* This amounts to the hypothesis that the agency possesses "free will"; it can choose the shape and/or evolution of the universe. This statement resem- one which might be made concerning the "Will of God". It can also be seen as affirming the final "randomness" of the universe.

Suppose that one chooses randomness over God. Then one denies the potential to define an automaton (computative agency) in which this randomness is synonymous with systemic volition. This is not justifiable; no reason for such a denial can be derived within our logical syntax. So, in the absence of logical restriction, let us redefine *"this agency"* as just such an automaton. This compels us either to loosen the definition of "volition", or to define a syntax around this randomness that would justify its volitive or cognitive interpretation. This is the issue on which the debate between theism and atheism finally rests.

Fortunately, this issue is resolvable. Consider what we mean when we say "mind". The mind is that which computes in the widest possible sense relative to an individual entity. It is purposive in the sense that it responds to the needs and desires of that localistic entity. It thus possesses an algorithmic structure. In alliance with a material brain, it takes the form of an algorithm running in a concrete device. By Γ-extension, it may be "hyper-deterministic" relative to the device, controlling or modifying it through mechanisms not intrinsic to the device itself.

Being algorithmic, the mind can be described as a hierarchy of computative invariants. Conversely, in the absence of any means to distinguish mind from algorithm, any computative control hierarchy can be characterized as *mental*. Γ is such a hierarchy. So Γ is mental, and may be defined as (part of) the "Mind of God". You may regard this definition as mathematical rather than proselytic. This Mind, of which Γ is the humanly-describable part, is somewhat like the minds existing within it: either it has free will, or it does not. If it does not, then its own evolution inheres entirely in itself; it is formally (inferentially) complete and potentially "omniscient". If it does, then it is even more powerful; it has the power of self-modification, and can creatively redirect itself according to Γ-nonrecursive functions with extraneous or random parameters. This, in fact, is a condition for the "free will" of human beings; without it, psychological causation regresses to deterministic closure. So those who attack theism with arguments against omniscience engage in a rather counterproductive pastime.

Living beings, and their "minds", are merely figmental in the Mind defined above. Such beings may, in their hubris, attempt to cast this Mind in a form as close as possible to themselves; from this, they typically derive much comfort and self-esteem. But a little reflection reveals the futility of placing locally-derived restrictions on global reality, a practice whose devotees resemble the tail that wags the dog...or the mice who demand that the ele-phant in whose shadow they play stand on a mousey-scale to prove that he meets the minimum weight requirement for heavyweight mouse wrestling. It is this very kind of absurdity that has enabled so many of us to deny, under cover of "logic", the wherewithal of our collective existence.