The Qualitative Aspect of Classical Logic and its Relation to *Laws of Form*

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> … the primary form of mathematical communication is not description, but injunction. In this respect it is comparable with practical art forms like cookery, in which the taste of a cake, although literally indescribable, can be conveyed to a reader in the form of a set of injunctions called a recipe. Music is a similar art form, the composer does not even attempt to describe the set of sounds he has in mind, much less the set of feelings occasioned through them, but writes down a set of commands which, if they are obeyed by the reader, can result in a reproduction, to the reader, of the composer's original experience.
>
> George Spencer-Brown, *Laws of Form*, Notes to Chapter 2[1]

I would like to start this paper with a culinary, artistic, and literary reference – a reference to *The Magic Pudding* by Norman Lindsey:[2]

I will shortly explain what puddings have to do with the link between classical logic and Spencer-Brown's Calculus of Indications (CoI) outlined in his book, *Laws of Form* (LoF). For now, I would like to tell you a bit about *The Magic Pudding*.

Norman Lindsey's 'magic pudding' is a pudding with personality – it can change its ingredients at will – whether providing its owners with a hearty steak and kidney main course or a plum pudding dessert, the quality of its mood remains the same. It is a grumpy, unpleasant character that loves to complain, resents being eaten, yet loves being the centre of attention at any meal. However much of it is eaten, its substance remains unchanged; it despises any abuse of power, and is a stickler for correctness and justice.

It has much in common with logic, which Mortimer Adler described (along with its Trivium partners, grammar and rhetoric) as 'an intellectual or liberal art … and a formal science … concerned with the forms of any subject-matter'.[3] A pudding or cake, as the opening quote states, is like a musical composition, or like mathematics. The difference, where logic is concerned, is that logic is an instrument of the intellect acting in and on itself through the means of reason. It is a triplicity: at

[1] (Spencer-Brown, 1969/2011, p. 64).
[2] (Lindsay, 1918/2006)
[3] (Adler, 1936, p. 2) (II.1.a.(1),(2)).

once taste, pudding, and recipe / music, musical performance, and score / mathematical demonstration, mathematical practice, and mathematical proof.

Think, for a moment, of how logic has been used, treated, and interpreted over the centuries, from its beginnings in oral traditions and the arguments characters get into in early epics, to more recent forays into algebraic and mathematical logics … if logic were to come to life and comment on how it's been treated – as the magic pudding is able to do – what might it say? If it were defending itself in a court of law against abuse, who might it draw on for its defence; who might it accuse?

Imagine for a moment, a court room. On one side, we have traditionalists; on the other, modernists.

In the former camp, one might easily imagine Parmenides, Aristotle, Boethius, and medieval realists, along with Jacques Maritain, a French philosopher, whose *Petite Logique*, 1923, was reprinted 10 times by 1933 and translated from French to English in 1936. In it, Maritain accuses 'Leibnitz and certain logicians in his tradition' of neglecting the '*operation* for the *product*, and the immaterial product of the mind for its *material sign*' and 'James, Bergson, LeRoy' of the 'Anti-Intellectualist school' of confusing 'the operations and products of the intelligence with the *material signs* by which they are expressed'.[4] The group might also include Mortimer Adler, who stated in a 1936 lecture that 'so-called mathematical logic confuse[d] grammar and logic' and that the 'proper study of logic requires that logic be assigned its place in relation to grammar and rhetoric',[5] his protégé, Sister Miriam Joseph, author of *The Trivium*,[6] and the Norwegian philosopher, Else Barth, who as recently as 1992 lamented the pitiable state of logic, asking, 'What has happened to the science of logic, to logic as an academic discipline and pursuit? Though the diagnoses do not coincide, many agree that something has gone seriously wrong.'[7]

In the latter camp, we might find the nominalists, along with Boole, the grandfather of algebraic logic; Venn, Euler, Peirce, Mitchell,[8] and Carroll, all of whom came up with their own ways of symbolising logical relationships; Sheffer, who in 1913 saw the importance of 'reducing the number of primitive logical constants';[9] Russell and Whitehead, whose work Sheffer references;[10] and Łukasiewicz, who felt the need, in 1957, to redefine the Aristotelian syllogism, stating that 'all expositions [of the Aristotelian syllogistic] … written not by logicians but by philosophers or philologists who either, like Prantl, could not know or, like Maier, did not know modern formal logic … are in my opinion wrong. I could not find … a single author who realized that there is a fundamental difference between the Aristotelian and the traditional syllogism.'[11]

But which side represents the witnesses for the defence; which for the prosecution? If the witnesses for the prosecution were formed of traditionalists accusing the algebraic logicians of abusing logic, would they have an open and shut case? After all, not all traditionalists were averse to using shorthand symbols for or visualisations of logical terms and relationships. In their defence, not all modernists are totally divorced from tradition.

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[4] (Maritain, 1937, p. 7).
[5] (Adler, 1936, p. 1) (1.2.a.).
[6] (Joseph, 2002).
[7] (Barth & Krabbe, 1992, p. xi).
[8] (Mitchell, 1883, p. 87). Mitchell's approach is particularly interesting in this context, as it respects distribution.
[9] (Sheffer, 1913, p. 482).
[10] Ibid. note †.
[11] (Łukasiewicz, 1957, p. viii). For a critique, based on flimsy evidence, see (Prior, 1962, p. 116).

On the one hand, Aristotle used shorthand letters for terms, Jacques Maritain came up with an algebraic calculus (see graphic directly below):[12]

As an example, for the sole purpose of showing the way in which we could set about to do this, let us select some elementary signs such as the following :

T to indicate the identification of the Pr. and S. in an affirmative proposition,

X their separation in a negative,

Ṫ or Ẋ a *suppositio* taken in relation to ideal existence,

Ṭ or X̣ a *suppositio* taken in relation to real existence,

a capital letter at the beginning of a word to indicate that the term is taken universally,

a parenthesis, a term taken particularly,

brackets, a singular term,

the sign →, to indicate an inference (" therefore ").

Obviously this list could be considerably extended. But even with signs as elementary as these it is easy to elucidate a good many interesting points. Thus, in order to translate the syllogism " Every man is mortal, but Peter is a man, therefore, etc.," into this system of signs, we would say :

Man Ṫ (mortal)
Peter Ṭ (man)
→ Peter Ṭ (mortal)

Setting forth the syllogism in this way shows forth the fact that the singular minor (and similarly the conclusion) have a *suppositio* taken in relation to real existence, and also the fact that it affirms an essential Pr. of the S.[1]

Simple conversion would be translated by the following symbols :

A X B
B X A,

or :

(a) T (b)
(b) T (a)

[1] This is regularly the case in singular propositions, as we said above (84 II, § 4) concerning some universals.

as did Leibniz, in whose work, a clear precursor to Spencer-Brown's mark can be seen, although I don't think Spencer-Brown was aware that he was aware of it:[13]

[12] (Maritain, 1937, p. 289).

[13] (Castro-Manzano, 2017, p. 102).

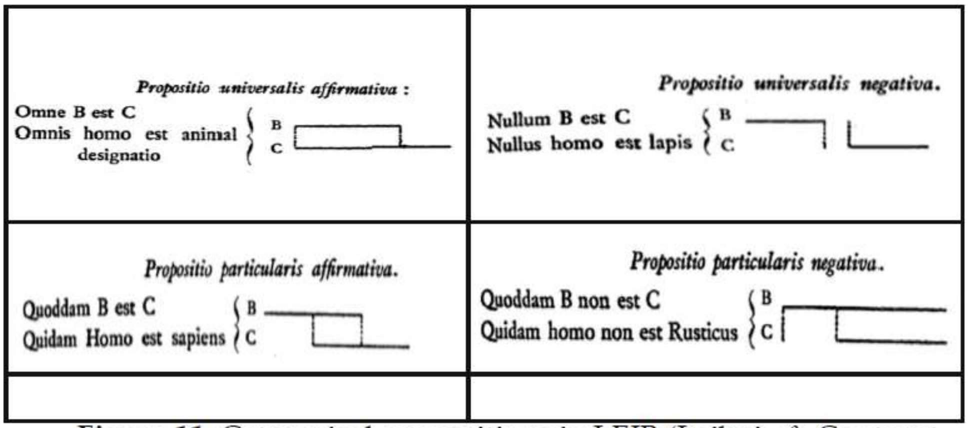

Figure 11. Categorical propositions in LEIB (Leibniz & Couturat, 1903, 292-293)

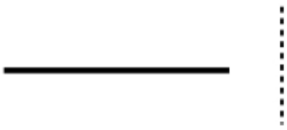

Figure 12. Vocabulary of *LEIB*

On the other hand, Leibniz sought to realise the Oneness of Being in his explorations of monadology, and of minimally elegant forms (his solution, however much he wanted to think of it as unary, was problematically binary):[14]

Boole, the grandfather of algebraic logic, talked in classical terms, as Maritain did, of apprehension, conception, and reasoning. He acknowledged the universe, and that the 'limits of discourse are co-extensive with those of the universe itself',[15] however, his association of 1 with the universe and 0 with nothing,[16] following on from Leibniz' ideas along the same lines, would create fundamental problems that remained unresolved until George Spencer-Brown's work appeared.[17]

But which side would George Spencer-Brown be on?

[14] Illustration source: (Wolfram, 2013). For an in-depth discussion of the problematic aspects of binary thinking, see (Naydler, 2018)–his section on Leibniz is at pp 160–169.
[15] (Boole, 1853, pp. 42–43).
[16] Ibid., pp 47–48.
[17] A useful outline and critique of 19th Century formal and mathematical approaches can be found in Chapter 8 of (Read, 1898, pp. 79–88).

Although he was influenced by the work of the ‘Cambridge logicians’, he was also a visionary thinker.

Elsewhere, I have shown how Spencer-Brown’s CoI, when used to facilitate the practice of classical Aristotelian ‘term logic’, has considerable advantages over other systems proposed to visualise logical relationships.[18] The application is based directly on—but differs from—Spencer-Brown’s application of the CoI to the practice of logic in Appendix 2 of LoF.

In the process, I have often felt like I was criticising Heston Blumenthal for having ‘too many raisins’ or ‘too much salt’ in his Christmas Puddings, or criticising Mozart for having 'too many notes' in his music or ‘too many instruments’ in his orchestra. If I am proved wrong for not having appreciated something Spencer-Brown was doing, or for having misunderstood it, then I would be very happy to be corrected. In either case, I see the CoI emerging even more strongly as a powerful, simple, elegant calculus which is applicable in so many areas.

In this paper, I intend to explore three things relating to George Spencer-Brown’s work on logic. Two are hitherto unexplored areas: (a) how he treats the logical distribution of terms, and (b) how he treats the qualitative aspect of logical figures and syllogisms implicit in Aristotle’s work, explicitly recognised in medieval logic, and conspicuous by its absence in many algebraic logics.[19] The third (c) is a deeper exploration of the implications of the mark as a means of checking the formal validity of syllogisms. I see distribution as being analogous to a pie dish; the qualitative aspect of the classical syllogisms as being analogous to pie awards; and validation as being analogous to the temperature probe used to check that a pie is cooked through properly.

Logical distribution of terms (the pie dish)

In Appendix 2 of LoF, Spencer-Brown carries out the promise outlined in the introduction ‘to separate what are known as algebras of logic from the subject of logic, and to re-align them with mathematics’.[20] In doing so, Spencer-Brown sees no distinction between implicative relationships, negation, and the contradictory of a term. For him, ‘*x* implies’, ‘not-*x*’, ‘~*x*’ are symbolised as ‘*x*, mark’:

$$\overline{x\,}\rceil$$

This, to me, is like looking at the shape of a pie without linking it, at the very least, to the pie dish in which it was baked, let alone anything else; or like looking at a pie dish without linking it to pies in any way. Like it or not, form and content are inextricably linked.

Spencer-Brown then proceeds to show how three simple logical algebraic expressions (the conclusions of which are true, false, and indeterminate) can be worked out using the system, following them with increasingly complex examples by Maurant and Carroll which lead him to a discussion of the problem of existential import which arises with respect to the 19th century modification of the Aristotelian square of opposition. The issue of existential import is less of an issue in classical logic, where truth value can be argued to power the system, than it is in Boolean logic.[21]

[18] (Conrad, Laws of Form: Laws of Logic, 2016), (Conrad, Laws of Form–Laws of Logic (Talk), 2016).

[19] There is, for example, not a single mention of the term ‘distribution’ or its cognates that I could find in the whole of Volume I of Russell and Whitehead’s *Principia Mathematica*.

[20] (Spencer-Brown, 1969/2011, p. xiv).

[21] The issue should rightly be seen in the context of Aristotle’s larger corpus, especially the Categories and his distinction between substance and attributes, along with his notion of substance being that which distinguishes a living being from a corpse in *De interpretatione* 21a20.

Interestingly, Spencer-Brown himself solves Carroll's logical problem using the very same single-level shorthand method which I have shown is sufficient to work with – it is elegant, minimalistic, and efficient. It reveals that, at the heart of his approach, there is an internal intuitive understanding (unacknowledged or unrealised by Spencer-Brown) of the role of distribution in distinguishing between the four moods of classical logic (**AIEO**, standing for universal affirmative ('all *x* is *y*'), particular affirmative ('some *x* is *y*'), universal negative ('no *x* is *y*'), and particular negative ('some *x* is not *y*') – the shorthand letters being taken from the first and second vowels in **A**ff**I**rmo and N**E**g**O** standing for universal and particular propositions respectively, their positive and negative qualities matching the concepts of the words in which they appear). When Spencer-Brown's mark of distinction is used as a mark of distribution, it brings distribution to the fore and highlights it as one of the central elements of logical reasoning. Spencer-Brown's >2-level notations all reduce to the following single-level forms with no loss of meaning, and considerable gains in efficiency:[22]

A: $\overline{\ x\ }\rvert\ y$ **I**: $x\quad y$ **E**: $\overline{\ x\ }\rvert\quad \overline{\ y\ }\rvert$ **O**: $x\quad \overline{\ y\ }\rvert$

However, the **A** proposition 'all ~*x* is *y*', in Spencer-Brown's system (as outlined in LoF), would be scribed as follows:

A: $\overline{\overline{\ x\ }\rvert}\rvert\ y$

This would be reduced to '*x y*' by C1 (a move Spencer-Brown allows in his simplifications) which could easily be confused with an I proposition:

I: $x\quad y$

Implication is not the same as distribution; the act of negation is not the same as the use of the 'repugnant' contradictory of a term.[23] 'All ~*x* is *y*' and 'some *x* is *y*' are clearly not equivalent. Reserving the mark of indication for distribution and the tilde to denote the contradictory of a term (~*x*, ~*y*) makes Spencer-Brown's approach cleaner, more visually intuitive, more consistent and far less confusing formally and materially. The use of the tilde eliminates any chance of this confusion occurring:

A: $\overline{\ x\ }\rvert\ y$ **A**: $\overline{\ {\sim}x\ }\rvert\ y$ **I**: $x\quad y$ **I**: ${\sim}x\quad y$

The CoI, when used in a way that maintains these distinctions, becomes a powerful tool in the use of logic – as an organon. The link between the shape of the pie and the pie dish in which it was baked is restored; form and content reunited. This allows logic to come into its symbiotic own and work its magic, for in this world, where pie, recipe, taste – and even pie dish, oven, and maker are one and the same, there is *real* magic.

In the latter part of Appendix 2, Spencer-Brown applies the CoI to an analysis of the relationships between the syllogisms of classical logic, 'finding … a set of 24 distinguishable valid arguments. Formally there is no difference between them. If we distinguish any, we should distinguish all. In fact not all twenty-four are distinguished in logic, which arrives somewhat arbitrarily at the number fifteen'.

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[22] (Conrad, Laws of Form: Laws of Logic, 2016, pp. 10, 13).

[23] 'Terms are repugnant when they are incompatible, that is, when they signify realities that are mutually exclusive, that cannot coexist in the same substance at the same time and in the same period. … Contradictory terms are necessarily repugnant, for example, white, nonwhite.' (Joseph, 2002, pp. 76–77).

The qualitative aspect of logical figures and syllogisms (the pie awards)

Interestingly, Spencer-Brown refers to valid classical syllogisms by the Latin names they are referred to in the medieval mnemonic rhyme which starts *Barbara*, *Celarent*, *Darii*, *Ferio* … and yet, judging by his comments cited above, he is either unware of—or chooses to ignore—the associated qualitative hierarchy inherent in the nomenclature. It is worth looking at the underlying principles behind the rhyme, which comes in various forms, the most common of which is:

> *Barbara*, *Celarent*, *Darii*, *Ferio*, que prioris
> *Cesare*, *Camestres*, *Festino*, *Baroco*, secundae.
> Tertia *Darapti**, *Disamis*, *Datisi*, *Felapton**
> *Bocardo*, *Ferison* habet, Quarta insuper addit
> *Bramantip**, *Camenes*, *Dimaris*, *Fesapo**, *Fresison*

* In these 4 syllogisms, the conclusions are modified from universal to particular to avoid a potential fallacy; the remaining 15 comprise the uncontroversially valid syllogisms out of 64 potentially valid possibilities.[24]

***B**arbara*, ***C**elarent*, ***D**arii* and ***F**erio* use the first free available capital letters in alphabetical order as keys to the 'secret code' medieval logicians used, **A** and **E** having already been used as shorthand symbols as explained previously. These four syllogisms are all in Figure 1, which Sister Miriam Joseph sees as the 'perfect figure', its form (with the minor premise stated first in her approach, as it is in Spencer-Brown's and in Russell and Whitehead's), flowing freely from term to term, and *Barbara* being the 'perfect syllogism in the perfect figure' as not only is it the only valid syllogism to result in a universal positive conclusion, but it is the only valid syllogism to be composed entirely of **A** propositions. In formal terms, *Barbara* is a number-one-prizewinning gold-medallist entry because it is the most universal. As long as the propositions are true, there's no arguing with *Barbara*.

Acknowledging this, the point of the mnemonic is to provide a means of perfecting every one of the syllogisms in the other figures by showing how to convert them to a first-figure form. They all start with **B**, **C**, **D**, or **F**, showing which of the first-figure syllogisms to aim for. The lower-case letters '**s**', '**m**', '**p**' and '**c**' act on the vowel directly preceding each of them. They can be easily rendered in English as standing for 'switch terms', 'move propositions', 'put up from **I** to **A** or put down from **A** to **I**' and 'prove by contradiction' (demonstrate the truth of an AOO-3 (*Bocardo*) syllogism by reordering the terms as an unsound **AAA-1** (*Barbara*) syllogism). The lower-case letters '**b**', '**d**', '**l**', '**n**', '**r**', '**t**' (think '**b**e**d**, **L**eo**n**, **r**es**t**') have no bearing on the process of working with the syllogisms.

It is interesting to note that Spencer-Brown's use of the CoI shows up the inherent formal and material opposition of **A** and **O** propositions in his choice of notation which simplifies to single-level mirror image forms (see above). However, he sees all three syllogisms, *Barbara* and its two opposed syllogisms (*Bocardo* and *Baroco*) which play on the oppositional **A**/**O** relationship and require proving by contradiction in the medieval system, as being equivalent. This is a clear confusion of opposition and equivalence; form and matter. This is like saying that because steak and

[24] Syllogisms are composed of two propositions. Each proposition can be in one of 4 moods. That gives 16 potential pairings. Each pair can be in one of 4 figures. That gives 64 potential propositional pairs. In practice, 8 of these can be eliminated, reducing the number of potentially valid options to 32, which can be further reduced to 15 uncontroversially valid pairs using the rules of classical logic. (Conrad, Laws of Form: Laws of Logic, 2016, pp. 14–15), (Joseph, 2002, pp. 134–138).

kidney puddings and Christmas puddings are both called puddings, it makes no difference at all when they are served, or what order they are eaten in. Any self-respecting pudding would object in no uncertain terms. I would expect logic to do the same. The confusion is eliminated if the mark of indication is used strictly as a mark of distribution and the rules of classical logic adhered to. But, as Spencer-Brown shows, and as I have confirmed, if an expression symbolising a syllogism reduces to an empty mark using the initials and consequences of the CoI, then the syllogism can be said to be valid, so what does this mean in terms of the relationship between the mark and logic?

The implications of the CoI in validation (the temperature probe)

Once one is familiar with the initials and consequences of the CoI, it offers a powerful and reliable tool for validation. Spencer-Brown, and Mingers have shown that this works; I have verified this and shown that consistent and reliable approaches for validation using the CoI are possible.[25] Treating terms as marks, and crossing or marking the propositions, without needing to take on Spencer-Brown's interpretative associations for conjunction and implication, the approach shows that if any of the 15 uncontroversially valid syllogisms are validated using C1, C2, C1, C2, J1, and C3 in strict order, skipping a step if it cannot be carried out, then whenever a syllogism reduces to an empty mark, it will be valid; if any of the 9 controversially valid syllogisms are validated using C1, C2, and a 'mark over mark' results anywhere in the expression, then the syllogism will be valid.

Thus, the process of validation using the CoI simply requires the two premises to be marked. Rather than seeing this as an act of implication or part of the marking of a joint act of conjunction and implication, as Spencer-Brown would, I simply see it as placing a 'mark of validation' on the premises to validate the conclusion, as one might apply a temperature probe to a pie to go through the process of ensuring a pie is cooked through properly.

Whether there is inherent meaning in the fact that the 15 uncontroversially valid syllogisms reduce to an empty mark, and the 9 controversially valid syllogisms reduce to the middle term with a 'mark over mark' over it is a moot point. Either way, they point to the fact that form does not equate to truth; it equates to form, beyond the paradox of duality: to the ineffable.

In this sense, the link between the CoI and the I Ching, specifically as it relates to the notation of logical propositions, is worth contemplating. This is something I have explored elsewhere, and I reproduce a table from my work on this here which points to the link. Here, terms are taken as marks, and the resulting pairings of marked and unmarked states are linked to the basic digrams of the I Ching:[26]

In Spencerian notation		In words	In traditional shorthand	In symbolic form	In the I Ching
$\overline{a}\rceil$	b	All *a* is/ are *b*	**A** (**A**-ffirmo)	**⌝** ⌝	⚋ ⚊
a	b	Some *a* is/ are *b*	**I** (Aff-**I**-rmo)	⌝ ⌝	⚊ ⚊
$\overline{a}\rceil$	$\overline{b}\rceil$	No *a* is/are *b* (or All *a* is/ are not *b*)	**E** (n-**E**-go)	**⌝** **⌝**	⚋ ⚋
a	$\overline{b}\rceil$	Some *a* is/ are not *b*	**O** (neg-**O**)	⌝ **⌝**	⚊ ⚋

[25] (Spencer-Brown, 1969/2011, p. 101), (Mingers, 2014, pp. 13–15), (Conrad, Laws of Form: Laws of Logic, 2016, pp. 16–20).

[26] (Conrad, Integration in the Liberal Arts: Harmony in the Trivium; Logic in the Quadrivium - RILKO Lecture, 2020), from 31'48" to 48'52"; (Lewin, 2018, pp. 304–327).

Conclusion

In Appendix 2 of LoF, I believe that George Spencer-Brown's approach to using the CoI in the practice of logic pointed the way towards a harmonious reconciliation of traditional classical and Boolean approaches. The CoI's power lies in its unary (rather than binary) approach. This makes it a powerful tool. This is why it provides such a robust system of notation of logic. This is why it puts distribution back where it should be, at the heart of the form and matter of logical thinking, revealing the beauty inherent in reason, as revealed by the rules of classical logic.

In the practice of post-Boolean algebraic logics, the dismissal of the qualitative aspect of syllogistic forms and figures that was recognised by classical and medieval logicians has resulted in a huge loss in terms of the art and science of logic. The relationship between the algebraic logics as systems and the practice of engaging in logic has become analogous to the twelve-tone compositional system and the practice of engaging in making music. The tones are *not* equal – mathematically or harmonically. The CoI offers a potentially fruitful means of returning to the work of Boole and Leibniz. It reconciles algebraic and traditional approaches. It brings early attempts at forumulating an algebraic approach to the practice of logic together with the traditional practice of seeing logic as an organon for perfecting the human spirit. I believe logic was understood in this way and practised in this spirit by Socrates, Plato, Aristotle and his predecessors, especially Parmenides, in whose work the universe is described as ineffable revelation, and any naming act a simulacrum, and in whose work, perhaps, *form*, as Spencer-Brown saw it, had an early exposition in relation to truth and logic. It remains to us to take Spencer-Brown's work further, innovating within tradition, rather than going against it.

The proof, as the saying goes, lies in the 'classical logical pudding'. I have consistently found the 'algebraic logic puddin'' to be neither wholesome, nor nutritious. It makes me want to say, along with Norman Lindsay's 'magic puddin':

> O, who would be a puddin',
> A puddin' in a pot,
> …
> I hope you get the stomach ache
> For eatin' me a lot.
> I hope you get it hot,
> You puddin'-eatin' lot![27]

The 'classical logical pudding', however, is the gift that keeps on giving – and Spencer-Brown's work points to a key that can bring it to life – in us. All that remains is for us to taste-test both 'puddings' and make up our own minds – not just logically, but intuitively, instinctively, imaginatively, inspiredly.

Bon appétit!

[27] (Lindsay, 1918/2006, p. 34).

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