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Commentary on Untitled Video Assemblage

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This assemblage illustrates a philosophical point which I raise in my book, a point concerning the relationship between addition and multiplication. The following is an adaptation of the relevant passage:

'...multiplication is clearly a more complicated matter than addition. Addition is well understood, but as the mysteries of the prime numbers are gradually revealed to you, it will become clear that we don't fully understand multiplication or, more precisely, that we don't understand the relationship between multiplication and addition. Louis Kauffman, a University of Chicago mathematician whose wide-ranging interests include the philosophical foundations of mathematics, makes this point:

> "Multiplication is more complex [than addition]. When we multiply 2×3 we either take two threes and add them together, or we take 3 twos and add these together. In either case we make an operator out of one number and use this operator to reproduce copies of the other number."

The word "operator" is used a lot in mathematics, incidentally – it's meaning is very precise, but for our purposes it can be thought of roughly as "something that does something to something else.'

The point that Kauffman is making is that with multiplication, the two numbers involved are playing different roles...

Think about it this way: 2 and 3 are counting numbers. In the context of "3×2", what are they counting?

The 2 could be counting steps taken along a line, beans placed on a table or marks made on paper. 3 is counting the number of times this action of taking two steps, placing two beans on a table or making two marks is performed. These are very different kinds of counting.

In the case of the 3, the things being counted (something happening twice) all have the number 2 somehow buried inside them. They can all be "segmented" into two similar pieces. These pieces are the things which the 2 is counting (steps, beans, marks), and these are not "segmentable". They're basic units, the sorts of things counting numbers are usually thought of as counting. But multiplication suggests another kind of counting – "the counting of countings" or counting turned in on itself. This innovation has some very strange consequences, the irregularity of the prime number sequence...being just the beginning."

In our assemblage, the categorical difference between addition and multiplication is illustrated using assemblages of small cameras and video screens. The wheeled platform moves along a track between two positions. The front position illustrates the simple fact that $3 + 2 = 5$, with the fixed assemblage splitting the image of the rabbit into two identical images and the moving one splitting it into three. In effect, one assemblage is "twoing" the rabbit and the other is "threeing" it. Both are performing the same kind of role, and this is made clear by the fact that the grouping of two screens and the grouping of three screens are positioned beside each other on a line. The back position illustrates the (less simple) fact that $3 \times 2 = 6$. The fixed assemblage again splits the image of the rabbit into two, but now the camera on the moving assemblage is no longer pointing at the same thing as the other camera – it's pointing at the output of that camera, that is, at the pair of screens, representing the "twoing" of the rabbit. So the role of the 3 in this configuration is categorically different from the role of the two – to put it simply, the 2 is counting rabbits, but the 3 is counting 2's. Rabbits are well-defined physical entities which can be found in the external world (and hence counted), but what are "2's", and where would you find three of them?

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The original design didn't include the first stage of the assemblage (which involves a single screen). It would still have illustrated the above point, but the introduction of this seemingly unnecessary element adds another layer of meaning. The single screen effectively brings the physical rabbit into the world of number – it "ones" the rabbit, reducing it from an "actual" rabbit with distinguishing features to a mere token, representing the category of rabbits – the rabbit has been brought from the realm of matter into the realm of number. This ties in with the observation that there cannot really be two of anything: subjected to sufficiently careful scrutiny, any two "similar" entities will be seen to display differences. The "twoness" is not to be found in the external world, but in the human act of naming, defining and categorising. Only by reducing the rabbit to a numerical token, can it be meaningfully doubled or tripled.

An unintended consequence of the use of inexpensive cameras and video screens is the gradual loss of image fidelity which occurs as we move from three-dimensional rabbit to a single rabbit on a single screen, to two rabbits on two screens and finally to six rabbits on three screens. At each stage, the rabbit loses a certain amount of its identity. This corresponds nicely to the way that first counting, then addition and finally multiplication move us progressively further from the entities which are being subjected to these processes. We can imagine moving from, say, a veterinarian having direct contact with an individual sheep (with full awareness of its individuality as self-organising, metabolising, sentient being) to a shepherd counting of a flock of twenty sheep (with partial awareness of the individuality of each sheep) to a large-scale sheep farmer calculating that his ninety flocks of twenty sheep constitute a total of 1800 sheep (with almost no awareness of their individuality).

Although the distinction between multiplication and addition may seem a fairly simple and marginal issue in relation to the vast complexity of higher mathematical research, it acts as a starting point for the investigation of what is arguably the central mystery of mathematics – that of how the prime numbers are arranged within the sequence of counting numbers. The primes – 2, 3, 5, 7, 11, 13, 17,... - are those numbers which are indivisible. As division is a kind of the inversion of multiplication, the notion of "primeness" only comes into being when we start multiplying, that is, when we apply the number system to itself. Despite the culturally familiar, seemingly innocuous nature of multiplication, it is a conceptual innovation, a categorically different kind of use of number, and the consequences of this can be seen as a kind of "feedback" or "interference pattern" caused by the number system interacting with itself. The consequences of this are still being worked out, with the Riemann Hypothesis (the central unsolved problem concerning the distribution of prime numbers) having, after 150 years of futile efforts to resolve it, achieved the status of a "Holy Grail" of mathematics.

The philosophical implications of these issues for our understanding of time, perception and (perhaps) consciousness itself will be explored in the third volume of my *Secrets of Creation* trilogy.

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