

Figure 1: The white ball.

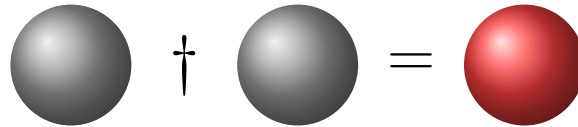


Figure 2: Two white balls in the machine produced a red ball when the \dagger button was pressed.

1 Early encounters

I saw objects sort of like molecules, balls of different colors joined by bars. Pairs of objects were placed in some kind of machine with four buttons, labeled \star , \triangle , ∇ and \dagger . After the pressing one of the buttons the original objects were gone, replaced by a new object. He showed me many demonstrations of this, pressing different buttons, with differently colored balls coming out connected in various ways. It was clear that he was trying to show me what this machine did, the look on his face said “you see, yes?” I tried to write down as much as I could afterwards, hoping that he would show me more next time. The colors definitely have meaning, there is a structure there. Two white balls make a red ball when you push \dagger and a red and white ball make a blue ball when you push \dagger (whether you blue white in the first or second slot does not appear to matter). He showed me a few with the \star button as well. A red and blue ball with \star makes just joins the balls by a black bar.

I thought I was starting to see the pattern, but then he showed me that a

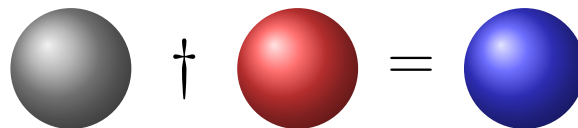


Figure 3: A white and a red ball in the machine produced a blue ball when the \dagger button was pressed.

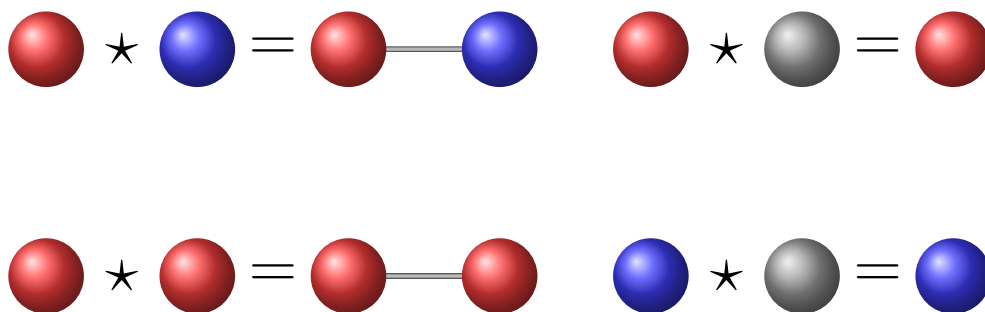


Figure 4:

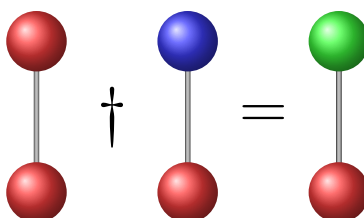


Figure 5:

white and blue ball with \star gives just a blue ball. Then things started to get really weird, with new ball colors appearing with no immediately apparent pattern. He showed me more images than I readily reproduce without it becoming overwhelming.

2 Possible patterns?

After four or five more encounters with this being, I was starting to have some guesses at some basic rules he was trying to communicate through all these examples. Pressing the buttons appears to start some sort of reaction inside the machine that combines the two objects. So, it makes sense to view \star and

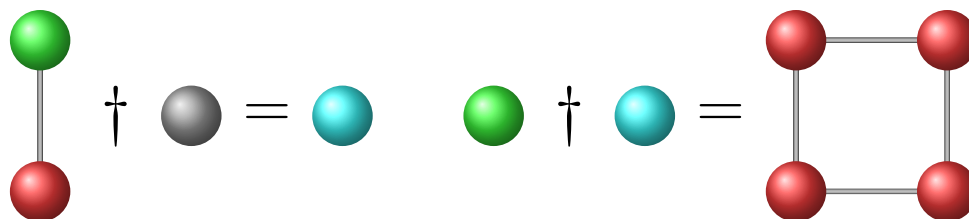


Figure 6:

\dagger is associative	$a \dagger (b \dagger c) = (a \dagger b) \dagger c$
\dagger is commutative	$a \dagger b = b \dagger a$
\dagger is distributive	$a \star (b \dagger c) = (a \star b) \dagger (a \star c)$
\star is associative	$a \star (b \star c) = (a \star b) \star c$
\star is commutative	$a \star b = b \star a$

Figure 7: Some plausible rules I will assume until proven wrong.

\dagger as binary operations. In all the examples I have seen, these operation have nice properties in that they are both associative and commutative. Actually based on the complete structures, they are not quite commutative, but if we consider two objects the same if they have the same number of balls of each color, then the operations are commutative. There is further structure in how the balls are connected by bars that does not behave commutatively, but I don't yet have enough information to even guess at how the operations work with this structure. For now, I am going to call two objects the same if they have the same number of balls of each color.

Definition 1 *A ball sequence is a sequence of natural numbers. Each slot gives the number of balls of a given color in order (white, red, blue, green, yellow, cyan, magenta, ...). Of course, these are just approximations of the colors I saw and there were many more. We will add to the list as needed.*

Conjecture 1 *The only ball sequence with a white ball is $(1, 0, 0, 0, \dots)$.*

Conjecture 2 *The ball sequence $(1, 0, 0, 0, \dots)$ has no effect when using \star , that is $(1, 0, 0, 0, \dots) \star b = b$ for all ball sequences b . In the absence of white balls, \star button just adds the values in each slot. That is,*

$$(0, a_2, a_3, \dots) \star (0, b_2, b_3, \dots) = (0, a_2 + b_2, a_3 + b_3, \dots).$$

In particular, \star never creates new colors.

3 The \dagger button is sort of like nuclear fission

I have seen applications of \dagger produce many balls from just a few. Figure 3 shows an example of this. It is almost as if the red balls are the simplest

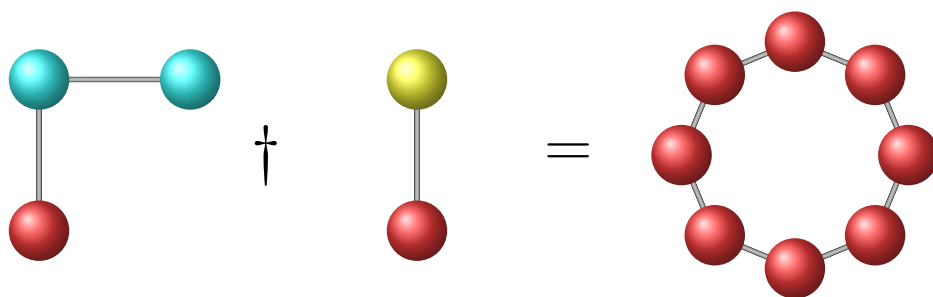


Figure 8: Some sort of splitting?

element and \dagger breaks down cyan and yellow balls into many more red balls somehow.