The Structure Mapping Engine

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SME

- A cognitive simulation program
- Genter's *Structure Mapping Theory* of analogical processing
- Both flexible and efficient using simple theory
- Generates all possible analogies and weigh how probable they are

The Structure Mapping Theory

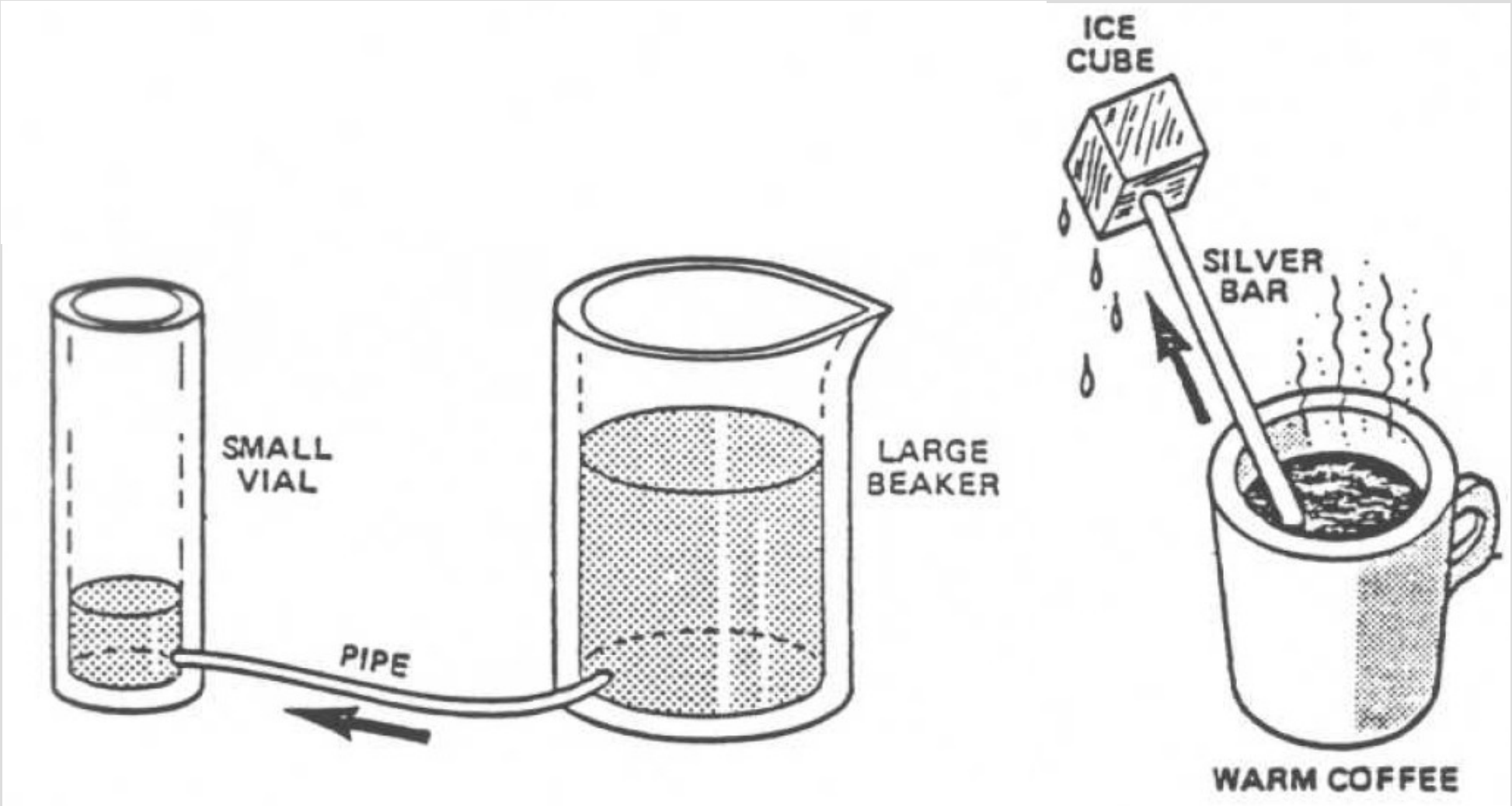
Analogy is a mapping
from one domain (the base)
to another (the target).

By analogy,
a system of relations holding in the base
should also holds in the target.

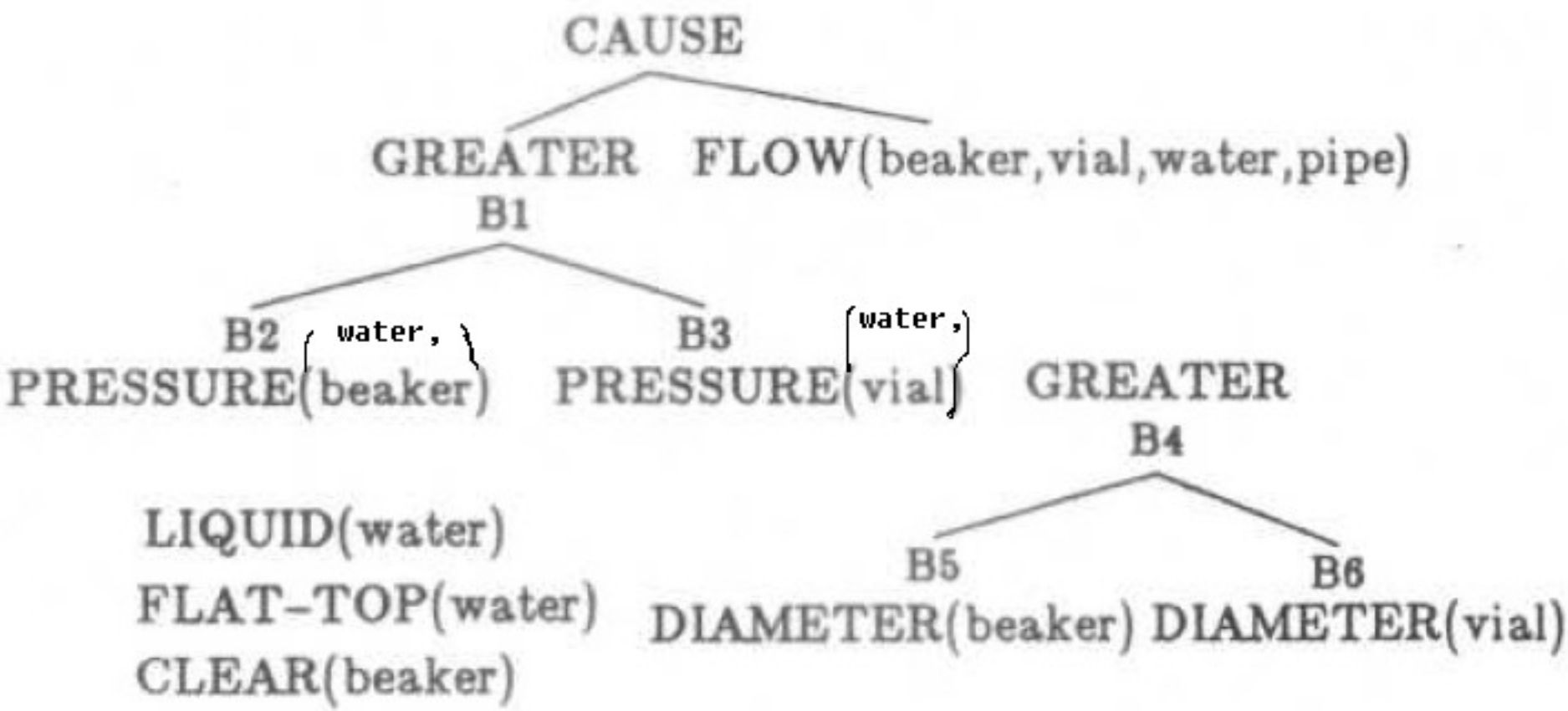
Basic Principles of Structure Mapping Theory

- Map objects $M : b_i \dashrightarrow t_i$
- Drop attributes of objects
  $RED(b_i) \not\dashrightarrow RED(t_i)$
- Map relations on objects
  $COLLIDE(b_i,b_j) \dashrightarrow COLLIDE(t_i,t_j)$
- Map higher-order relations by *systematacity*
  $CAUSE[PUSH(b_i,b_j), COLLIDE(b_i,b_j)] \dashrightarrow$
  $CAUSE[PUSH(t_i,t_j), COLLIDE(t_i,t_j)]$

Example: “Heat is like Water”



Water Flow


CAUSE
GREATER
FLOW(beaker,vial,water,pipe)
B1
B2
PRESSURE(water, beaker)
B3
PRESSURE(water, vial)
GREATER
B4
LIQUID(water)
FLAT-TOP(water)
CLEAR(beaker)
B5
DIAMETER(beaker)
B6
DIAMETER(vial)

Heat Flow

GREATER
T1

T2 TEMPERATURE(heat, coffee)

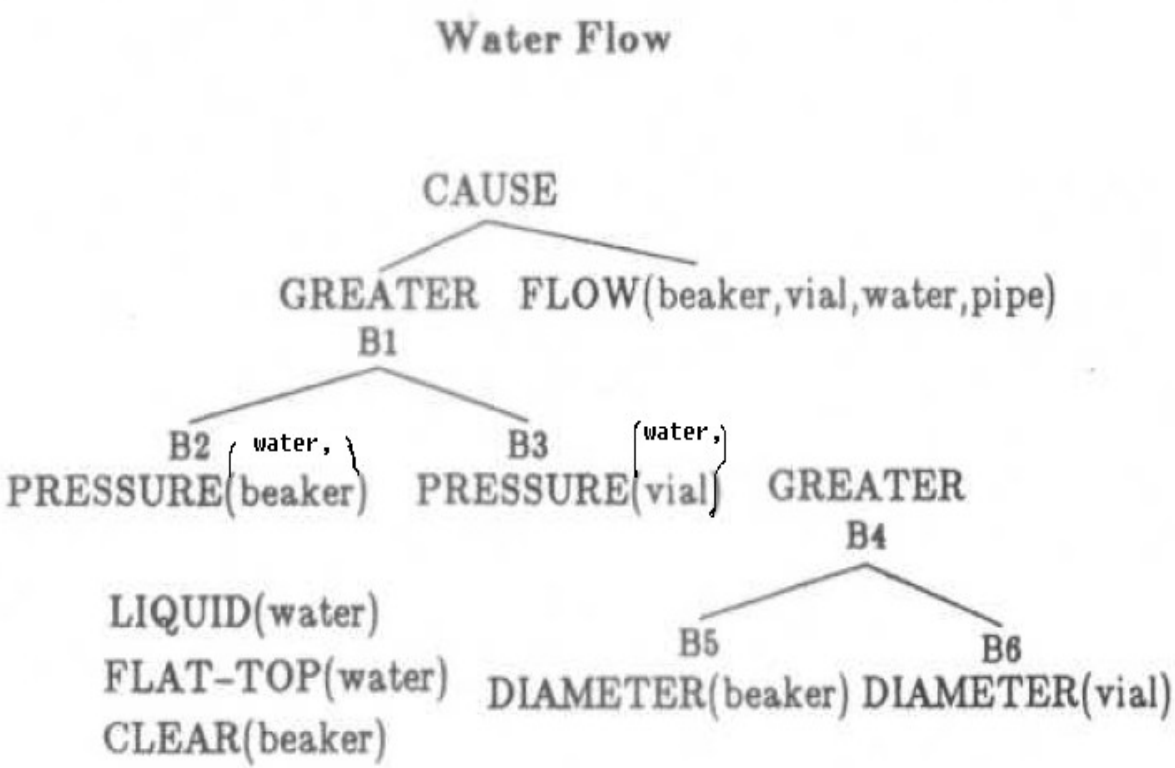
T3 TEMPERATURE(heat, ice cube)

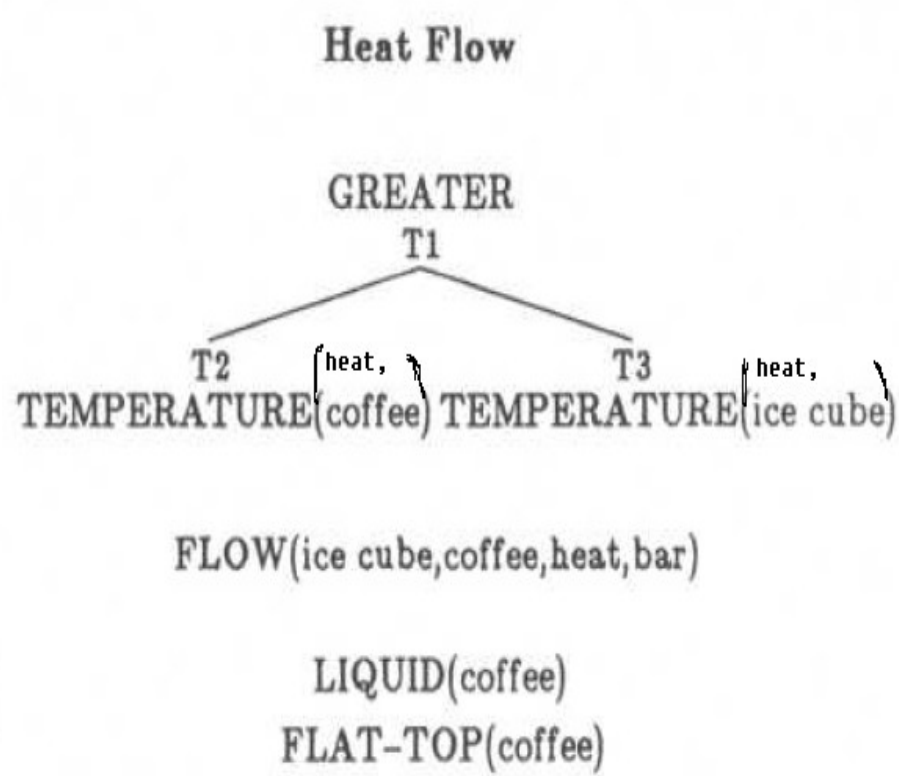
FLOW(ice cube,coffee,heat,bar)

LIQUID(coffee)

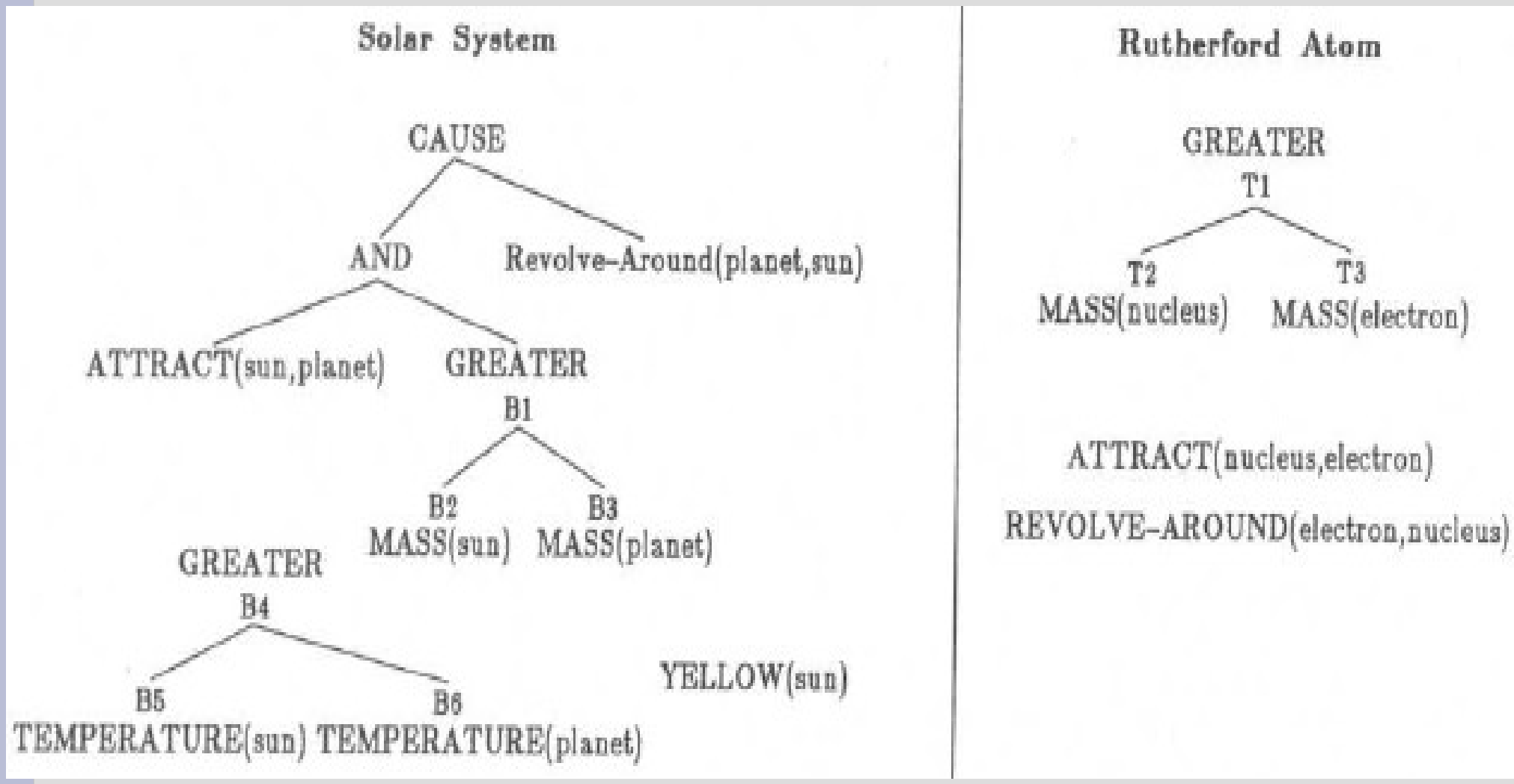
FLAT-TOP(coffee)

CAUSE(GREATER-THAN[
TEMPERATURE(heat,coffee),
TEMPERATURE(heat,ice cube)],
FLOW(heat,bar,coffee,ice cube))





Example: Solar System *vs* Atom



Some thoughts on SME

- Distinction between predicates and relations.
  FATHER(Tom, Bob)
  FATHER(Tom)
  In general arity problem
  TEMPERATURE(heat, coffee)
  TEMPERATURE(coffee)

- Mapping is not necessarily one-to-one.