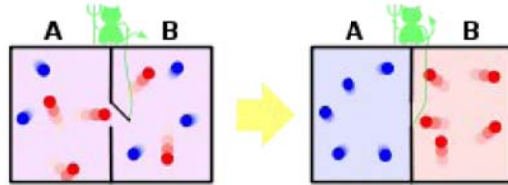


Information entropy and physical entropy

„ in an isolated system, entropy never decreases.” Second Law of Thermodynamics

The Maxwell demon

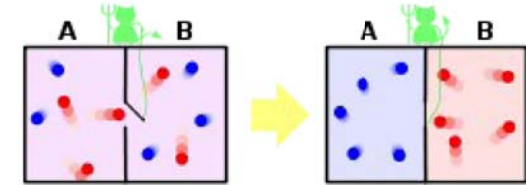


Temperature of A **decreases**, B **increases** → Violation of the Second Law ?

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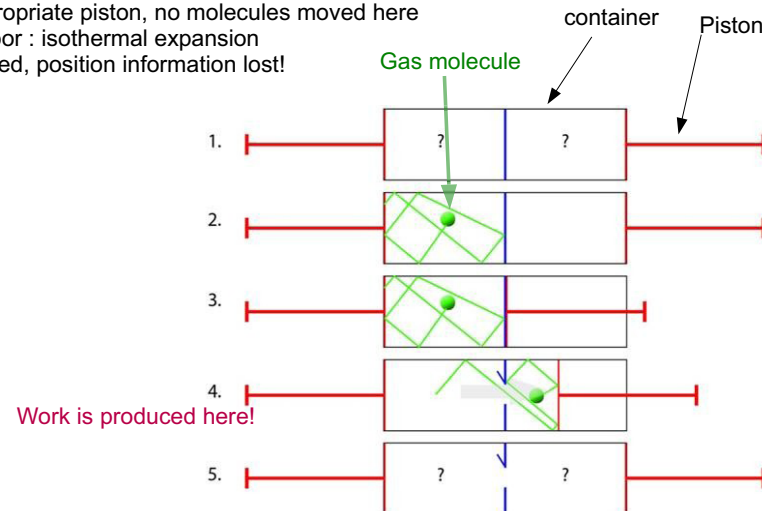


Temperature of A **decreases**, B **increases** → Violation of Law II. ?

Solution: NO, since the demon interacts with the system, it must be considered. The demon acquires **information**, and this changes its state!

Information entropy and physical entropy

1. : molecule's position unknown
2. : measure position, information = 1 bit
3. : move appropriate piston, no molecules moved here
4. : release door : isothermal expansion
5. : door opened, position information lost!



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$$W_{A \rightarrow B} = NkT \ln \left(\frac{V_A}{V_B} \right)$$

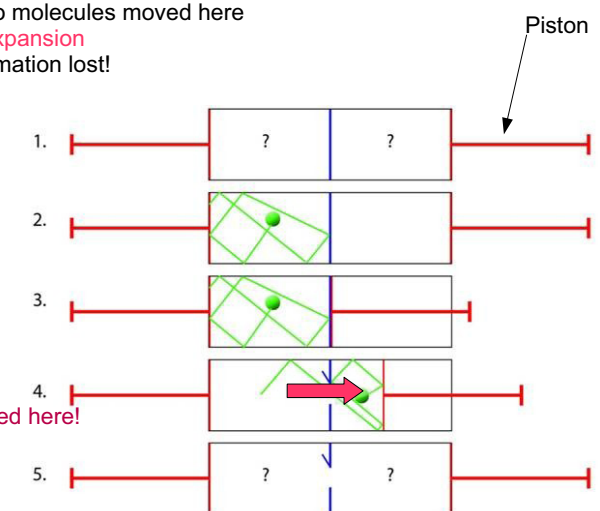
In this case:

$$N=1$$

$$V_A/V_B = 2$$

Hence

$$W = kT \ln(2) \text{ Work is produced here!}$$



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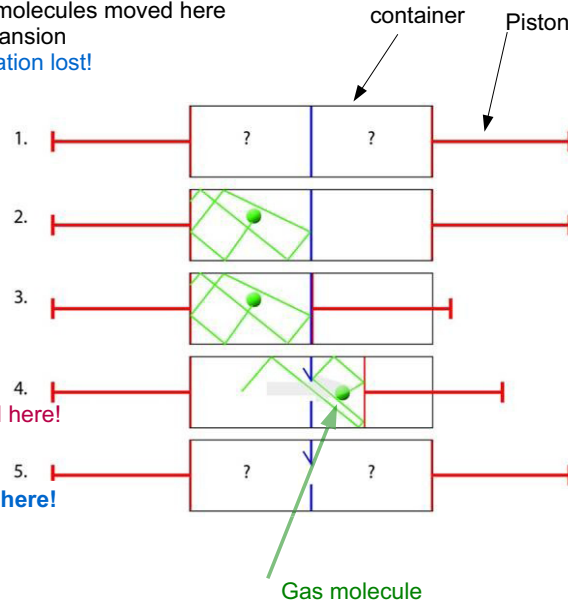
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Information is lost here!



Information entropy and physical entropy

Leo Szilárd:

From Law II. taking into account that $W = T\Delta S$

$$W_{\text{produced by piston}} = W_{\text{loss of information}}$$

$$T\Delta S_{\text{inf}} = kT \ln 2$$

$$\Delta S_{\text{1bit}} = k \ln 2$$

Erasing 1 bit of information increases physical entropy by $k \cdot \ln 2$

(Landauer 1971, logically irreversible processes, eg. AND-gate)

