# Sociophysics –
# - an astriding science

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# Sociophysics – what is this?

- a renewed attempt to combine the latest natural and social science theories… [P. Arnopoulos, 2005]
- …aims at a statistical physics modeling of large scale social phenomena… [C.Castellano, 2008]
- application of methods from (mostly statistical) physics to human relations; can be traced centuries backwards. [D. Stauffer, 2007]

## Sociology

– the systematic study of human society.

[J. J. Macionis and K. Plummer, 2005]

# Fundamental methodological disagreement in sociology

- The physical and social sciences are constrained to share key logical, epistemological and methodological features. [Emile Durkheim -positivism]

- The differences in subject matter are so important that any attempt to study them in the same way is doomed to failure. [Max Weber -'verstehen' sociology]

# Explanations and predictions in social and physical sciences

- The desired outcome of scientific investigation might be an explanation of analyzed phenomena.
- If an explanation is a good one then it will lead to successful prediction.
- Accuracy of prediction in both sciences tends to be understand differently:

  - expectations of the escape velocity of space shuttles or the trajectory of this shuttle?

Are different than:

  - expectations of changes in social structure in countries in transition.

# Why social sciences are so lousy in predictions ?

- More ‘standing conditions’ must be specified in order to describe even the most simple relationship.
- Difficulty relates to a perceived need to use the concepts of physics, or mathematics, for the purposes of describing the social world.
- Everyday life provides us with at least partial explanations that the social scientist, unlike their physical counterpart, must take in account in their formulations

# The Laplace receipt to know the future:

1. Determine the present state
2. Turn on the equation of motion

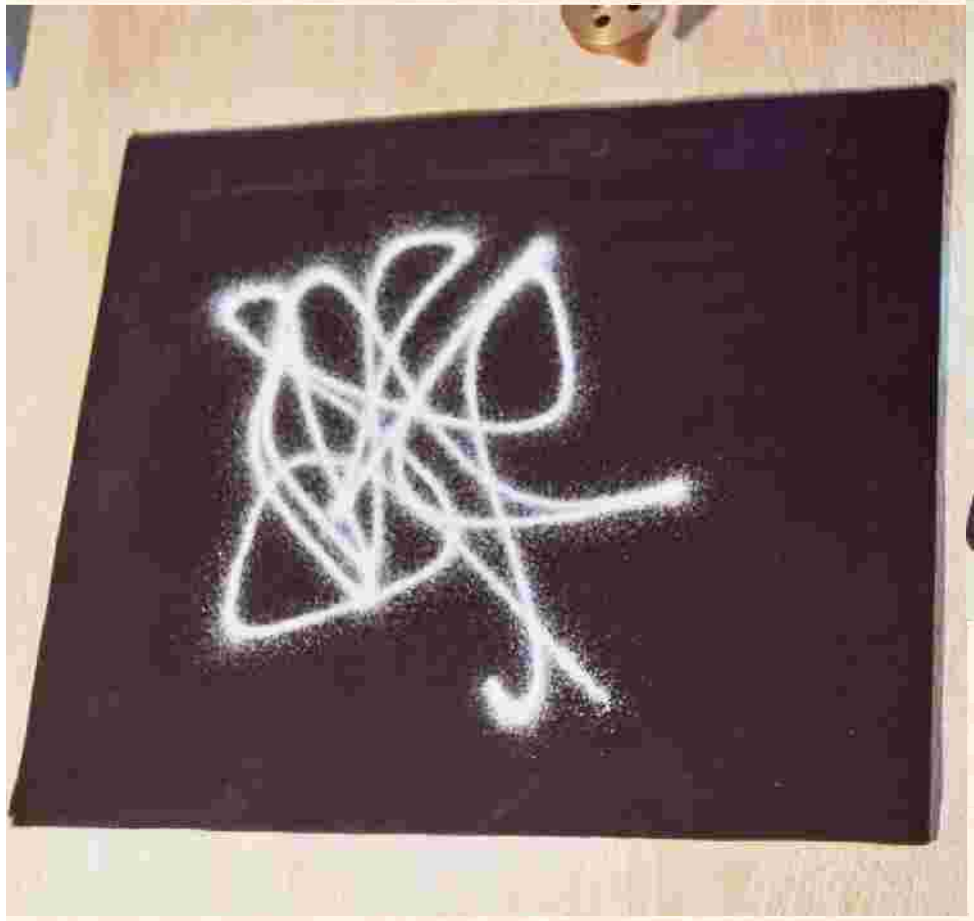
e.g. $x(n+1)= 4x(n)[1-x(n)]$

| n | x(n) | x'(n) |
|---|---|---|
| 1 | 0.5555550 | 0.5555560 |
| 2 | 0.9876545 | 0.9876541 |
| 3 | 0.0487720 | 0.0487738 |
| 4 | 0.1855734 | 0.1855797 |
| 5 | 0.6045438 | 0.6045596 |
| 6 | 0.9562823 | 0.9562691 |
| 7 | 0.1672258 | 0.1672739 |
| 8 | 0.5570454 | 0.5571733 |
| 9 | 0.9869832 | 0.9869248 |
| 10 | 0.0513891 | 0.0516168 |
| 11 | 0.1949930 | 0.1958102 |
| 12 | 0.6278831 | 0.6298742 |
| 13 | 0.9345836 | 0.9325307 |
| 14 | 0.2445483 | 0.2516687 |
| 15 | 0.7389777 | 0.7533263 |
| 16 | 0.7715585 | 0.7433030 |
| 17 | 0.7050238 | 0.7632145 |
| 18 | 0.8318608 | 0.7228724 |

# Demonstration of chaos: An unpredictable pendulum

Constructed at the
Faculty of Physics
and Applied
Computer Science,
AGH-UST

We cannot obtain
the same pattern...



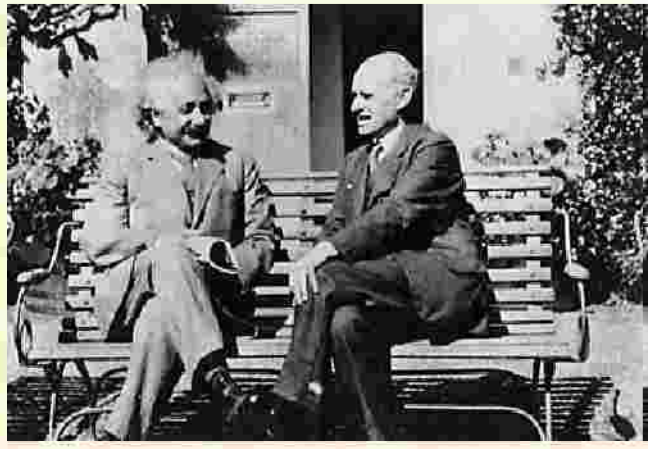
...twice.

# 2nd law of Thermodynamics :

# ENTROPY DOES NOT DECREASE

„ If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations, then so much the worse for Maxwell's equations. If it is found to be contradicted by observation - well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation."

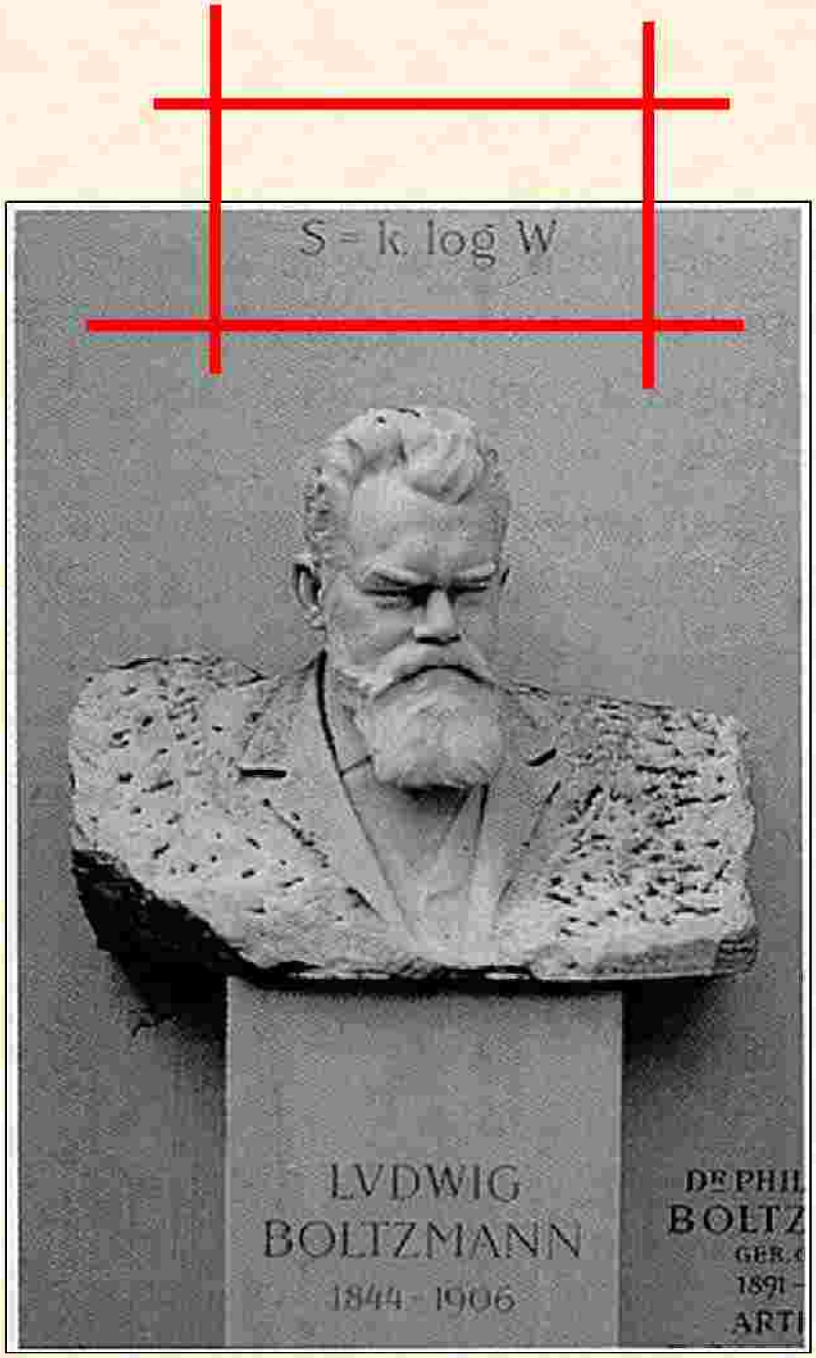
[Sir Arthur Eddington, astrophysicist]



Each macroscopic
state A
represents
a given number $\Omega(A)$
of microscopic states.

Entropy

$$S = k_B \ln W(A)$$

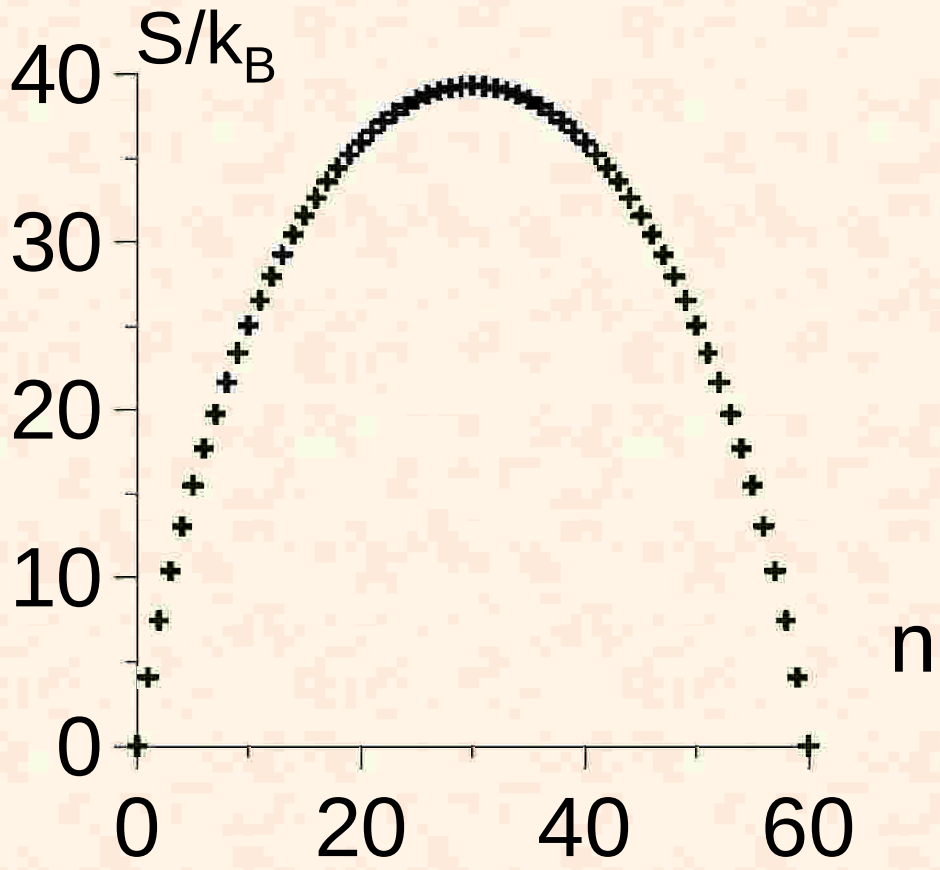


# An example: 60 red-white tokens

MIcroscopic state: RWRRWW....

MAcroscopic state : ***n***R, (60-***n***)W (12 R, 48 W or so)

$$\frac{S}{k_B} = \ln\binom{60}{n} = \ln\frac{60!}{n!(60-n)!}$$



# *conclusions*

- Since we deal with unpredictability in physics, then to treat social sciences differently in this dimension seems improper.

- Once laws of physics - as 2-nd law of thermodynamics - is a consequence of our way of measurement, and not an immanent property of Nature, then sociophysics offering to social sciences different ways of operationalization, can give them a new insight to their subject study, even if this insight does not cover the whole deep of human being.

*The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.*

**Sir Lawrence Bragg,**
**Nobel Prize Laureate 1915**