identifying emergence in complex systems

@thejunglejane

if you put **50 ants** on a table

if you put **500,000 ants** on a table

adding more **ants**

relatively **simple**

foraging for **food**

building **nests**

raising **livestock**

waging **war**

burying their **dead**

innate immune system

adaptive immune system

take the **lower levels** for granted

principle of computational irreducibility

the collective is irreducible to the individual

the whole must be greater than the sum of its parts

emergence

disorganized v. organized complexity

Per Bak

Chao Tang

Kurt Wiesenfeld

self-organized **criticality**

simple

distributed

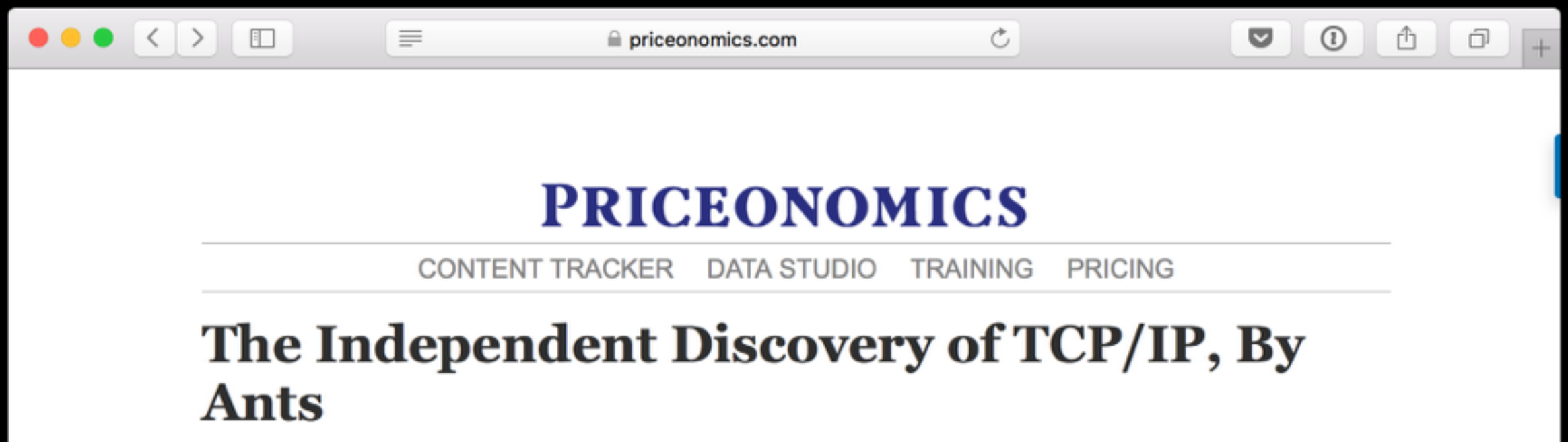
scalable

spend water to get water

collective regulation

ants are doing TCP

the independent discovery
of TCP/IP, by humans



David Winter

keepturningleft.co.uk

consensus

scale-free correlation

high signal-to-noise ratio

effective perceptive range

seven nearest neighbors

robustness

many evolutionary cycles

in many different environments

natural selection for **collective behavior**

we have many **biological analogs**
of computational problems

ants and congestion control

starlings and consensus

slime mold and network-routing

swarms and distributed search

neuronal spiking and probabilistic inference

fly brains and max independent sets

problem of **representation**

top-down **feedback**

simple and abstract

thank you