Sustainability, Science and Art

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"A Fluid Resilience"

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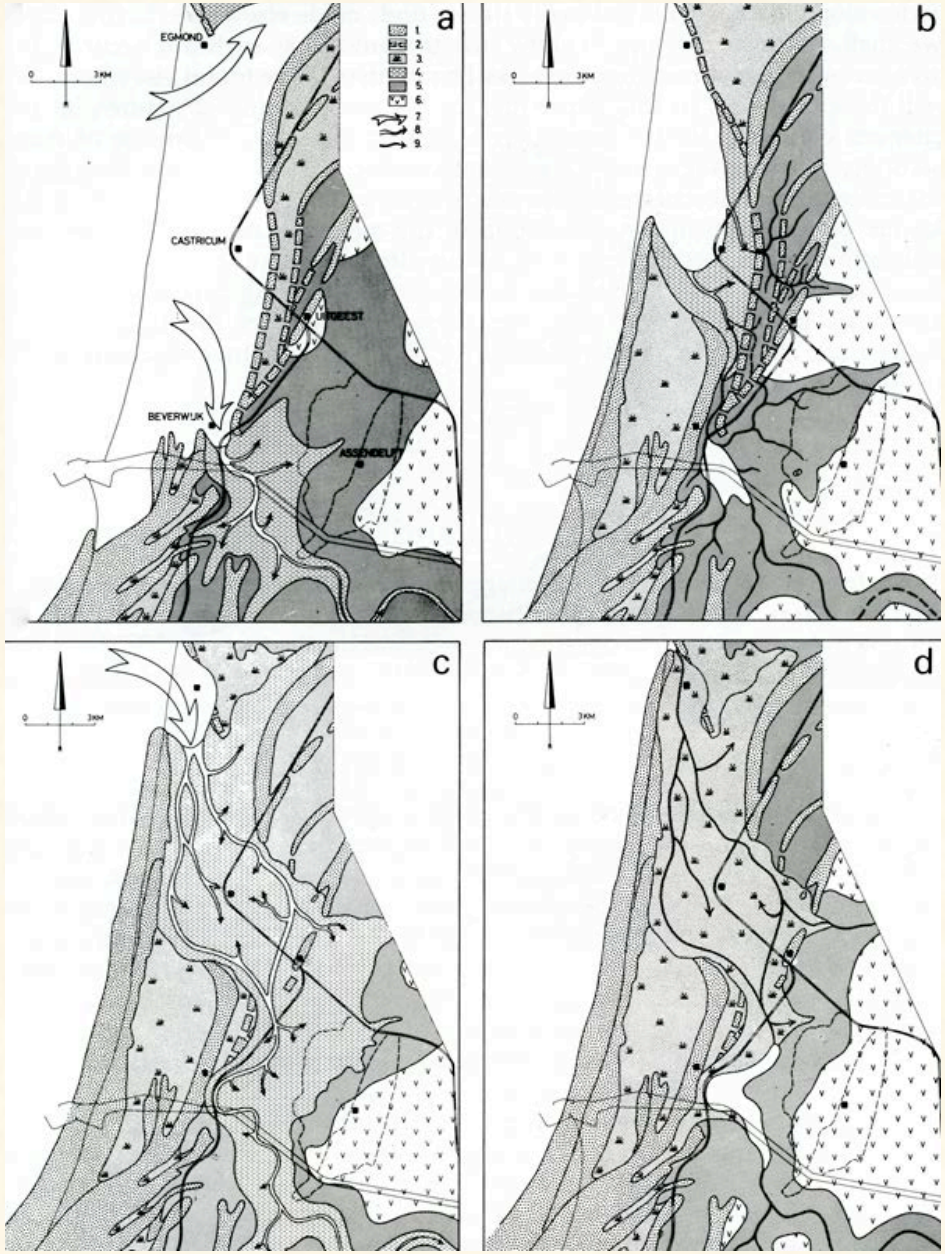
Rhine delta history…

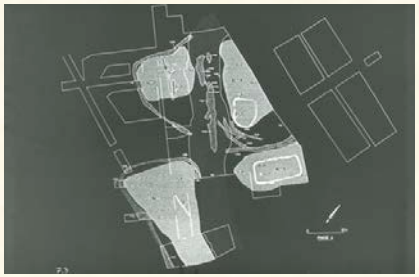
- Land needs to be protected and to be exploited …
  - From agriculture on fertile peat to stock-raising on infertile peat, to peat extraction, to inundations, and to drainage in order to regain fertile soil
- Individuals beget institutions and these beget individuals …
  - The dynamic between collective authority and individual ownership
- Technology has unexpected consequences …
  - It enables us to conquer nature until its consequences undermine the conquest
  - Then new technology needs to be brought in and the cycle repeats itself
- Together, they drive the system further and further from its point of departure …to the bottom of the sea

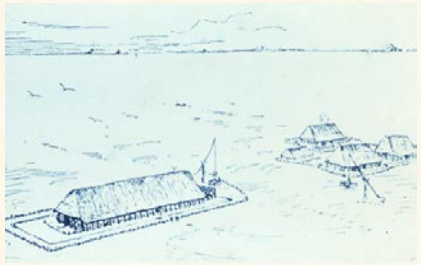


The prehistory of the Dutch coast

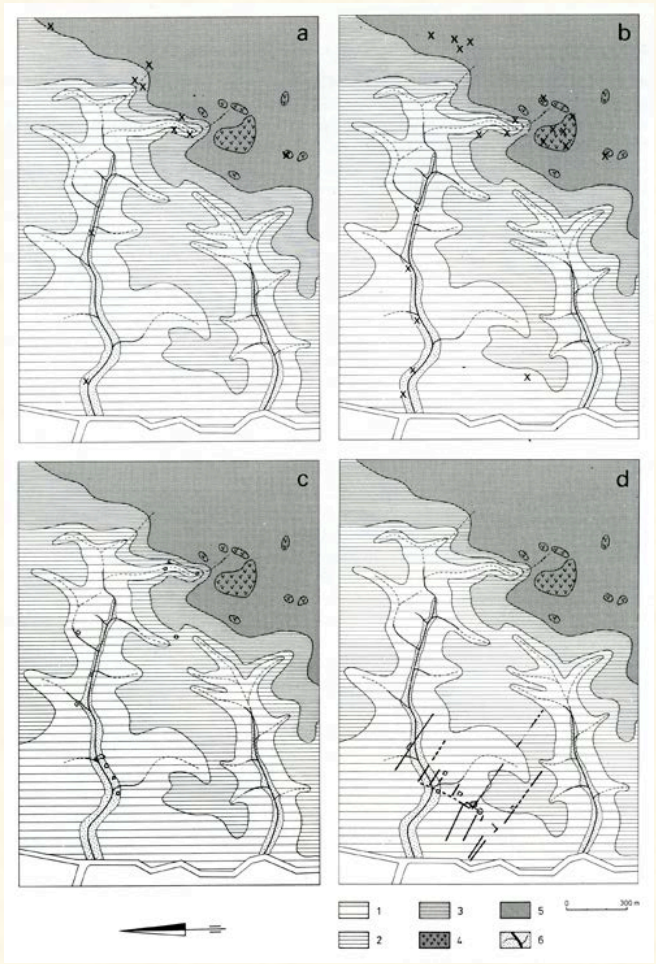
North Sea currents shifted the original mouth of the Rhine Northwards, creating a large area of peat

Early settlement

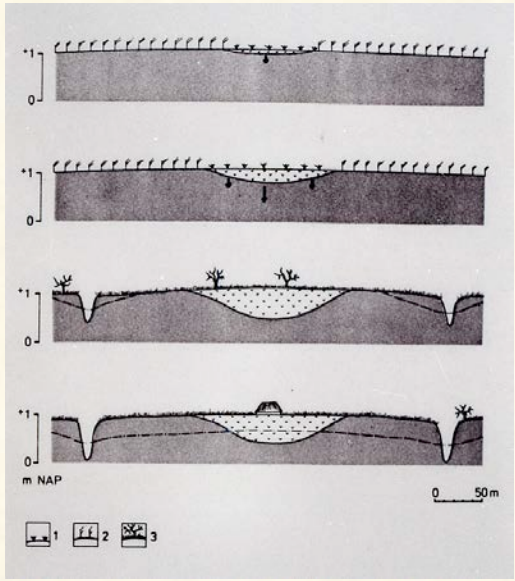




Isolated buildings in the marsh



Changes in settlement location



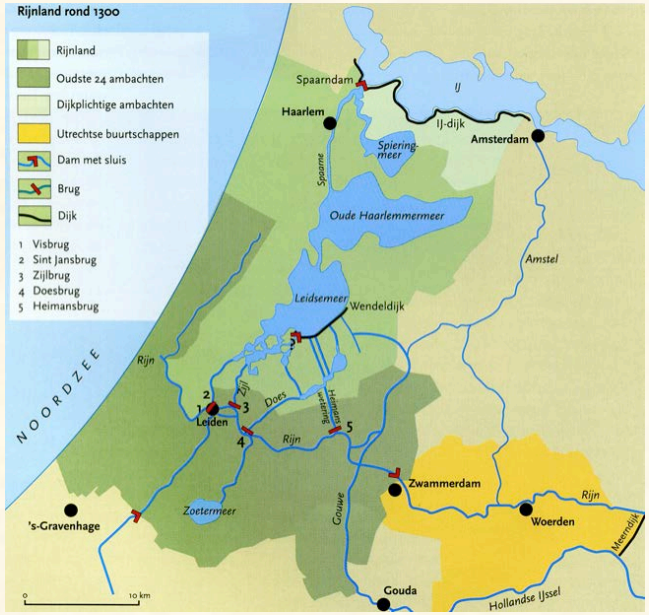
Drainage lowers the land

Land then needs protection against water

The Rhine delta in the Middle Ages

- From the 12th c., sea currents blocked the Rhine mouth (dunes) → inundations →inhabitants react collectively
- Rhine dammed upstream, canals redirect drainage towards the North and South.
- Locks built at edge of a lake, creating management at supra-local level

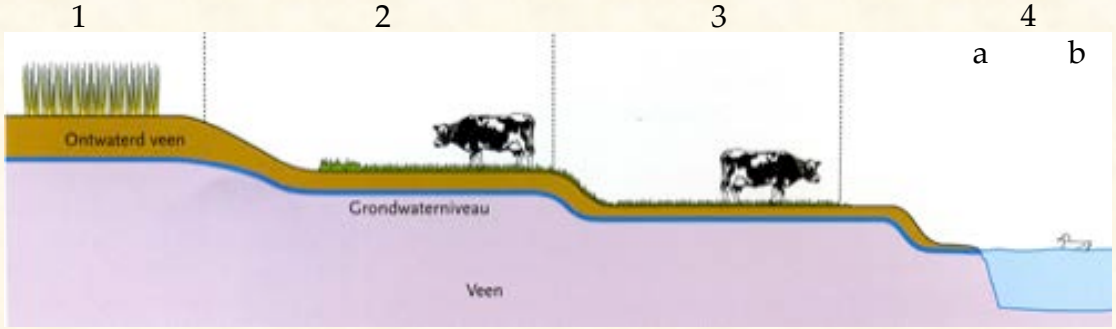
c. 1280



c. 1300

The first major transformations

- Feedback between drainage, ploughing, and oxidation → peat descended (c 1 m/century).
- The land became less fertile, drainage difficult – water to be pushed up from land into the (now higher) drainage canals.
- After 1475, war → grain prices rise → stimulating agriculture → windmills everywhere

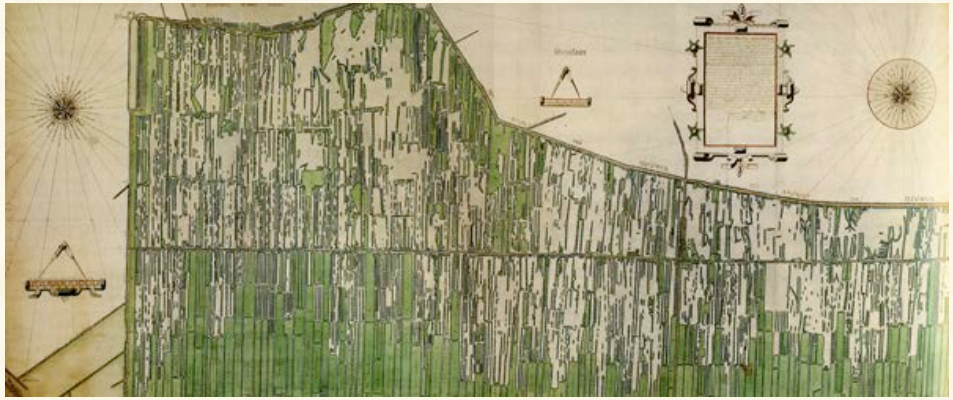


Four phases of exploitation: (1) agriculture, (2) good animal husbandry, (3) poor animal husbandry, (4a) peat exploitation and (4b) fishing

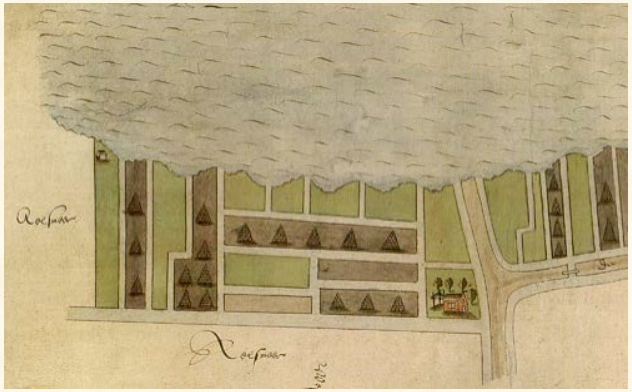
Lots of windmills after 1475

The rush to extract peat

- Cheap grain imported, meat and milk product prices high, →economy shifted to stock-raising
- Low local wages stimulated fishing, transport and trade, industry and urban growth
- Land surface (peat) dug away to provide fuel (peat) for industrial activities
- Open water undermined the stability of the remaining peat and creating ever larger lakes



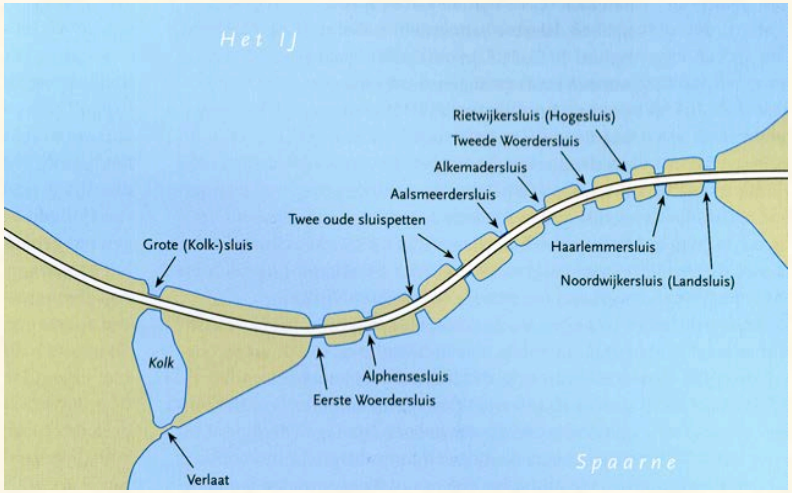
The results

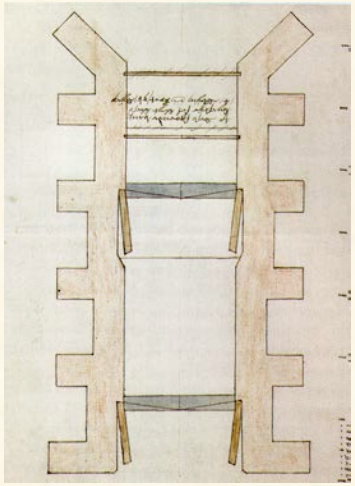


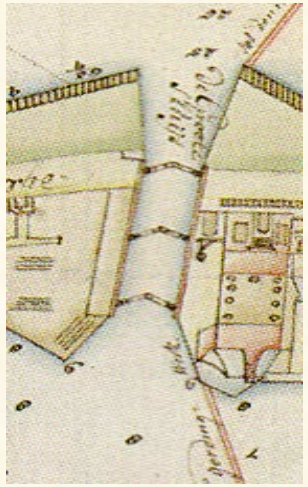
… and the consequences

From arbitrage to management

- Initially collective works involved donations of time, quickly replaced by wage labor paid for by a land tax
- As land disappeared, water management became financially strapped
- Water authorities brought water under control; improved locks, draining land during ebb, closing during high tide
- Limited peat extraction, made peat farmers buy land to guarantee tax payment, gained control over terrestrial activity



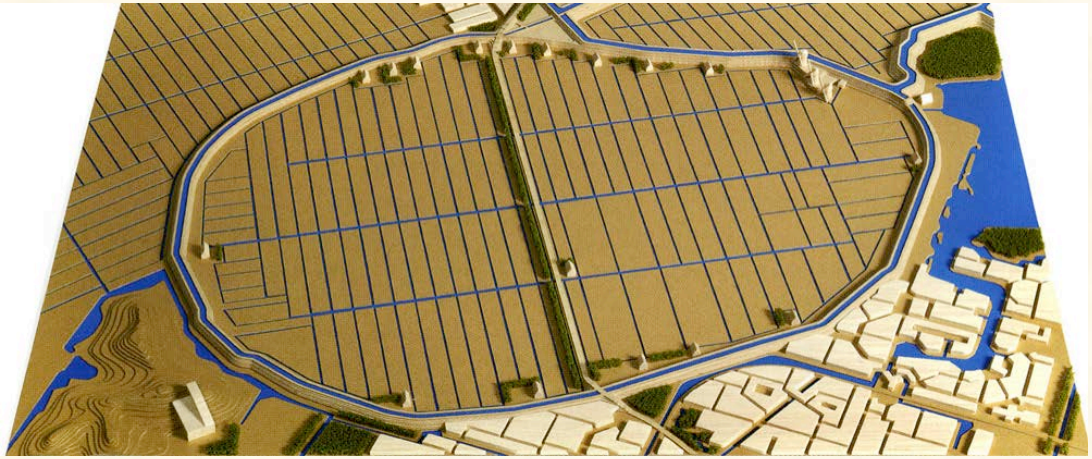




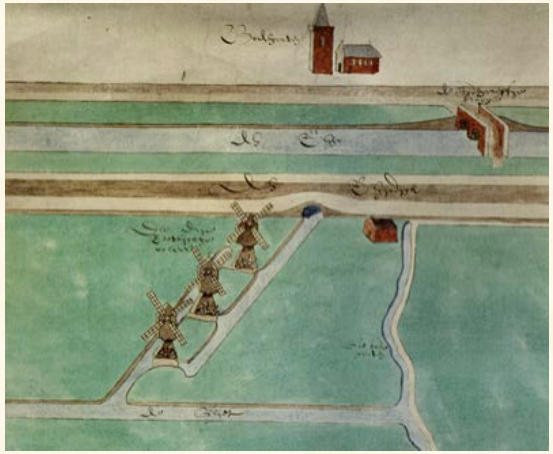
The locks at Spaarndam, c. 1500, moved with the tide

Economic growth and the first 'polders'

- From 1550 to 1660, poor immigrants kept the price of labor low, stimulating economic activity and the need for fuel.
- When land was burned away, new techniques for peat exploitation under water, down to clays and sands below.
- More open water, more dangers; while grain prices low, people only limited immediate dangers.
- As grain prices rose (1660's), the lakes were pumped dry to facilitate agriculture on the clays below



This model shows a circular drainage canal, windmills and land parcels between ditches

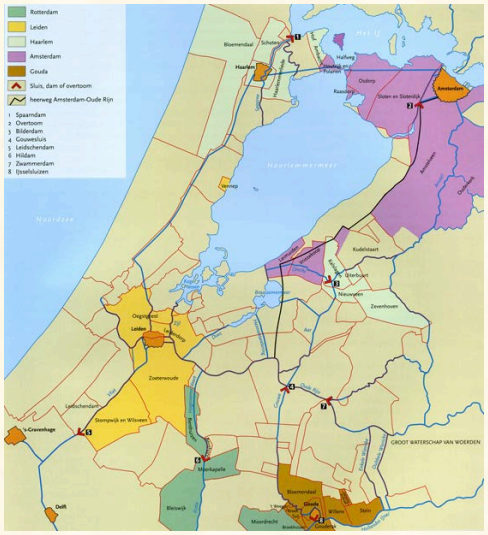


If the land is very low, 3+ windmills may be needed

The financial crisis

- Decline of peat production and grain prices impoverished the rural population. Urbanites bought and exploited much land
- In 1675, the protecting levee broke twice, just after a major war with France and England
- Amsterdam and other cities, took over repair and reinforcement of levees, shifting power to the cities.

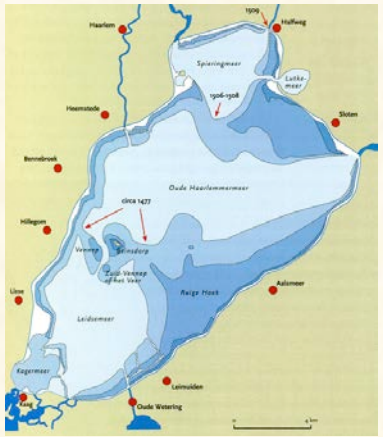
The dam at Spaarndam broke in 1675



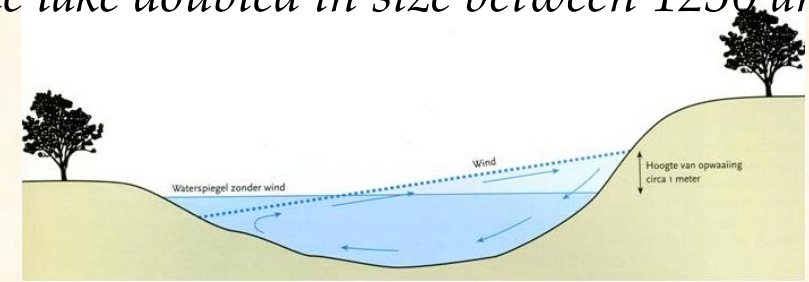
Land acquired by cities in the 17th and 18th cty.

Regaining lost ground

- In 18th c., peat exploitation reached its technical limits; protecting banks of resulting lakes increasingly costly
- From c. 1750 agriculture returned to profit, rich lake-bottom soils could profitably produce meat, milk,
- Rijnland funded the reclamation of lakes, investing its own funds or borrowing money against future taxes,
- There were limits to what could be done with windmills; steam engines enabled drainage oflarger 'polders'
- Haarlemmermeer, a major danger in the 18th C., drained in mid 19th c.



Peat winning weakened the edges of the lake, and open water caused wind and water to batter them. The lake doubled in size between 1250 and 1848.



Summary

- Water was initially a threat, to be fled, and then to be contained.
- People came to collaborate, develop techniques, solve differences of opinion, create institutions to contain the threat
- Land was transformed by individuals into fuel, creating more open water and undermining the institutions
- Water became a threat again, and land insufficient to provide food; water was (again) collectively transformed into land
- Cyclical 'Tragedy of the Commons' - individuals create water-related threats → institutions contain the water → individuals create new threats, → strengthened institutions…
- Scope and scale of threats and institutions grew to encompass all of the Low Countries, shaping Dutch society to this day …
- The driver is *the interaction between (short term) solutions and (longer term) unintended consequences*

Nature is culturally defined

- Until the 14th c, in Europe mainly a unified *vitalist* world view, in which all life is part of one grand scheme
- Under the impact of the great plague, separation between life and death, linear time (clocks), & c.
- From then, nature is dissected to promote understanding
- Growing empirism enhances knowledge of dead matter – *but fragmentation is its inevitable corollary.* Leads to tangled hierarchy between nature and culture
- Institutionalization of separate disciplines by creation of 19th c. university curricula further favors *reductionist view of complex system*
- Funding and technology give study of nature the advantage
- *The separation of nature and culture and the fragmentation of our world view are at the root of our sustainability challenges;* to overcome it we *must re-integrate* both spheres into an encompassing world view.

Both stories are part of a fundamental shift

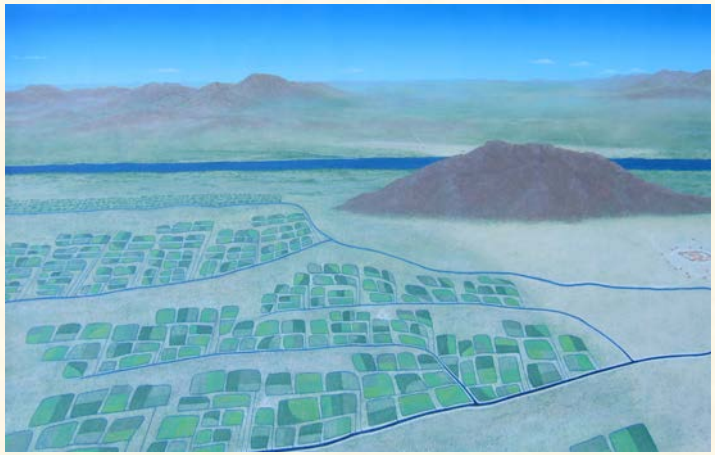
- Both show increasing control over limited domains and fragmentation of our knowledge, leading to crisis
- Our insights in the socio-environmental system involve a few dimensions, but our actions on it affect almost infinite dimensions
- Hence while our insights grow linearly or geometrically, the unanticipated consequences of our actions grow exponentially – *while we think we know more, in fact we know less and less*
- A shift occurs from frequently observed, minor risks to unexpected major risks – this builds up a *'risk barrier'*.
- Hitting it triggers a 'crisis' – *a temporary insufficiency of our information processing capacity to deal with the challenges facing us.*

Art involves more dimensions than science

- Art and creativity are fundamentally about the opposite of reductionism – *about increasing the number of dimensions we take into account by association*
- They are about the future rather than the past, emergence rather than origins, about enriching our perspective rather than reducing it.
- We should mobilize the arts around the theme of resilience …
- We need to effectuate a change of mind, but to do so we need to get people to think in creative alternatives
- I would therefore argue for early art education … more in general an emphasis on creativity rather than socialization in schooling
- And for a focus in art on synthesis rather than fragmentation …

Hohokam irrigation

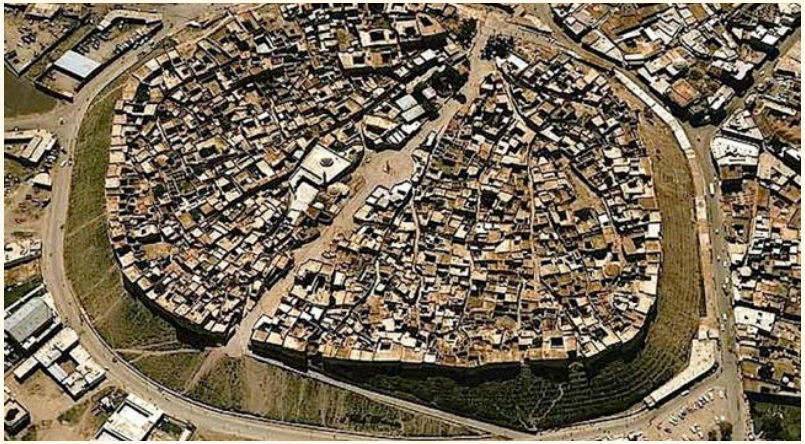
Map



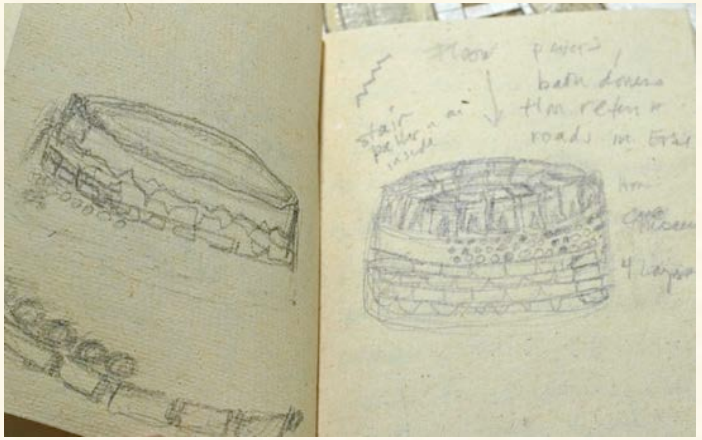
Drawing

Artist's impressions

The Erbil citadel



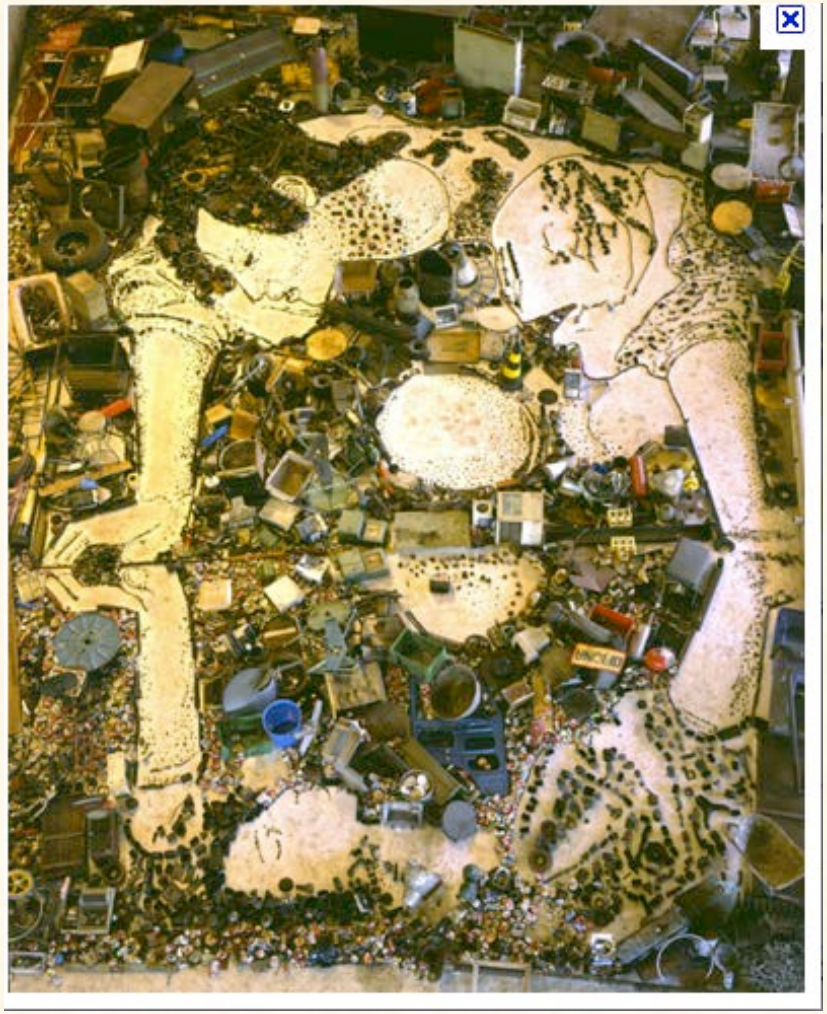
Photo



Idea

Artist

Artist's impression



Vik Muniz' work is another excellent example ….