

## **Invention/Innovation/Novelty/Art**

- Current definitions hopelessly confuse matters, e.g., Barrett Seaman in a 2000 issue Time Magazine review of "inventions"="We define an invention as something new, created by human ingenuity. It is not a discovery of a natural phenomenon that already exists. It is not merely a product of convergence, technology's latest buzz word used to describe the combining of existing technologies" [no, that is **innovation**]. Invention is very rare, like the discovery of fire, rotary motion or the atom. According to Homer Barnett, a 1950s American anthropologist, it is the discovery of a brand new **principle**, which, contrary to Seaman, is always preexistent in nature. Its "discovery" and application to technical problems is what precisely constitutes an "**invention**".
- "Convergence" then equals "innovation" as the recombination of known technologies in new **forms, functions** or **significations**. It is very common. Most "inventions" are really just "innovations".
- "**Novelty**" is a new form or signification searching for a function. It answers no cultural need and hence tends to disappear. "Novelty" is a wrong word used in the book on the zipper. As a form of "fastener" it was a critical, if minor, "innovation".
- Art** is also new behavior, but it affects the **internal** world of psycho-social reality, not the **external** world of objects and forces. Hence, while artistic traditions evolve like tech., they never, unlike tech, get any "better"; they are only "different" and run into Gunther Stent's paradox of "paraphrase".
- Design**, the reconciling of form with function (or, frequently, the lack thereof)  
"Generality of Demand/Specificity of Demand"  
As in art, the former generates invention or innovation, the latter "design".
- Yousuke Yamada, a senior engineer for Ricoh, was given a demand by the company president to create a device that would catapult his company, which had made its fortune in cameras and heavy office machinery, into digital personal technology. "The trouble was, Sakurai [the CEO] didn't really know what he wanted. 'The idea was to develop a product that uses all our senses,' says Yamada. 'There was no paper, no specifications. Just his wish, his hope'. Yamada stalked crowded subway stations on his 4 hour commute, where he likes to think, and came up with the first HTML coding digital camera/wireless web device, the \$1,500.00 RDC-i700, available by 2000 in Japan, that allows one to take digital pictures, scribble notes with a stylus and then convert the latter to text and move both to web sites for instant publishing via a wireless modem connection.

-Hamilton 2000:69

"Modesty"

-Until the 1800s it was customary for physicians to listen to heart sounds by placing their ears to the patient's chest. Dr. Laennec, a French physician, did not feel this was appropriate for female patients & so rolled up 24 sheets of paper to form a tube & discovered that the sounds were clearer; by 1815 he replaces the paper with a cylinder of beechwood & is accredited with inventing the 1st stethoscope; in 1852 Dr. George Cammann designed the binaural stethoscope, the modern form (perfected in 1961).

Primate Background  
(Ethology & Fossils)

6 million- Mitochondrial DNA indicates split from Apes between 6 4  
million & 4 million.

5 million= Kenyapithecus (knuckle-walker) ape & man ancestral  
form

4.4 million= Ardipithecus ramidus (Ethiopia) just tooth, but not robust,  
therefore probably bipedal (interact with world via  
hands, not teeth); Currently 17 individuals found;  
smaller molars, larger canines, thinner tooth  
enamel=diet rich in easy to chew fruits &  
vegetables; Discoverer Tim White of Berkeley

4.2 million- Australopithecus anamensis (lower mandible-straight & 3.9  
million ape-like but no canines, walked upright, Kenya), but  
not very well, unlike anything today, between  
knuckle-walking and fully bipedalism because the

arms are very long, therefore good in trees, paleo-  
botanical evidence indicates area still forested.

Discoverer Meave Leakey (wife of Richard) & Alan  
Walker believe A. anamensis develops into A.  
afarensis, looks good

3.6 million- A. afarensis (Lucy); most famous 3.2 million "Lucy";

2.9 million better bipedally than we are (narrower pelvis)-note  
**overlap** with Africanus, therefore out-competed;  
Lucy= 3'6" 65 lbs/ some males 5' 110 lbs=more  
highly dimorphic than at present, now only about 5"  
between modern men & women (Park 1994:66).  
[Geographica 186(1)]. They were better at  
walking; species endured for 9,000 centuries; at this  
time environment turned dry=savannah pre-

dominates; a 3.3 million A. afarensis may be  
represented in Sterkfontein, **1st eastern form in  
South Africa** & connector of A. afarensis & A.  
africanus; discoverer Ron Clark of Witwatersrand  
Univ.

3 million- A. africanus in South Africa "Taung baby" (500 cc.)

2.3 million could be S. African form of advanced A. afarensis

2.8 million- A. aethiopicus (Ethiopia), ancestor to A. boisei, wide face

- 2.3 million low brain case with big sagittal crest; overlaps with A. africanus (but in 2 different regions); Paranthropus is the better genus designation for all the robust forms
- 2.5 million= A. garhi, newest to be defined, an advanced A. africanus, Ethiopia, found with flake tool (out of pebble) & bones with cut marks (nearby), therefore **1st complex-technology & possible hunting** (carnivorous diet not just scavaging?; antelope skull shows scraping to remove tongue) **Overlaps with A. aethiopicus** (no tools); best candidate to give birth to genus Homo.; brain is a very expensive organ to allow to grow from the point of view of metabolism; it can grow larger (especially the cognitive areas) in a species that is consuming a lot of high-energy food (e.g., meat and fat)
- 2.4 million-H. rudolfensis (Kenya); early Homo habilis, high domed skull, looks very much like H. habilis-note **overlaps with A. aethiopicus**; earliest migration outside of Africa to China and Indonesia at 1.8 million
- 2.3 million-A. boisei (Olduvai Gorge, Tanzania) "Nutcracker Man", 1.4 million note, develops chronologically & morphologically right out of A. aethiopicus & **overlaps with** both H. habilis & early H. erectus, the latter did it in!
- 1.9 million-H. habilis (600 cc.) evidence for fire; **overlaps with A. boisei**
- 1.9 million-A. robustus, Kromdraai, South African form like A. boisei
- 1.5 million
- 1.7 million-H. ergaster, an early form of H. erectus in Kenya, wider, taller braincase than H. habilis; **the hominid that competitively excludes A. boisei** & migrates outside of Africa (to Europe & Southeast Asia)
- 1.7 million-H. erectus (900 cc.) in Europe & Java (trinit); 1891 250,000 **first technical discrimination of raw materials= crypto-crystallines**
- 1 million-200,000 Archaic forms in Africa antecedents to H. antecessor, i.e., a cranium from Buia, Eritrea with a mixture of H. erectus & H. sapiens (1,000 cc.?)

800,000= H. antecessor in Spain (last common ancestor between H. sapiens & H. heidelbergensis, an early Neanderthal)

600,000= H. heidelbergensis develops out of H. antecessor

500,000= archaic H. sapiens and H. neanderthalensis splits from H. heidelbergensis

200,000-30,000 H. neanderthalensis established as recognizable species  
lasts longest in Spain, isolated from H. sapiens;  
**first indirect technology=Mousterian tortoise core**  
**first religious consciousness (intentional burial);**  
**first art (simple beads; red ochre=body art)**

100,000= H. sapiens established as recognizable species; Cro-Magnon (**developed cave art 40,000**)

30,000= extinction of neanderthal (some interbreeding in Portugal as evidenced by 24,500 child skeleton by Eric Trinkaus of Washington University in St. Louis **but** Ian Tattersall of the American Museum says is just a chunky modern kid).

## Notes on Lansing & Bali

**Lontars**=the sacred bamboo texts that transformed a tribal animistic society into a theistic state

**Sawah**=wet rice paddy (a whole ecosystem=recycles human excrement as top of the trophic level super-predator to the lowest level:

- a.) "night soil"=paddy water
- b.) when harvest rice, cut just the head, return the stalk to the paddy=nutrients
- c.) nutrient-rich water causes blue/gree algae to grow
- d.) that fixes nitrogen for the rice as a nitrogen-loving plant
- e.) insects and tiny fish feed off algae
- f.) larger fish feed off smaller fish & insects
- g.) ducks eat fish and insects, people eat ducks & rice
- h.) back to "a"

**Tika**=the farmer's calendar of 10 different kinds of "weeks", some of only one day! Geared to the rice maturation cycle, independent of calendar time. Calendar is a luni-solar year, each day governed by complementary 1 demon and 1 god. Everything modeled on cycles, unlike Western linear time; a religion of "transformation"

**Gamelan**=Gong orchestra, organized like water temple hierarchy and calendar=**cross domain isomorphism**; small instruments (p.67) play short, repetitive cycles, larger instruments play at longer intervals, defining the beginnings & ending of melodies, long sections defined by the beating of big gongs. In the same way high-ranking water temples encompass the activities of smaller ones, same for calendars.

**Jero Gde**=Supreme Water Priest, a commoner, the living embodiment of the Goddess of the Lake.

Temples all look alike & are "vacant ceremonial centers", "except for a few days each year when festivals are held, they are generally left empty and abandoned" (Lansing 1991:3). Only exception is supreme Temple of the Crater Lake!

**Green Revolution**=developed in labs of the International Rice Institute of the Philippines in the 1960s centered on high-yielding dwarf rice hybrids that required much chemical fertilizers & pesticides. Spreads to Indonesia in the 1970s, officials urge continuous cropping to bolster international balance of payments & to ignore traditional schedules. **But** results in water shortages & outbreaks of pests

Traditional pest control=

-drain fields & burn rice stalks & the "coordinated fallow" (versus "delocalized" necessity of buying pesticides, with the latter's cost & ecological damage)

### **Theories of the Balinese States**

Classic Western Materialism as Ethnocentric Explanation

I.e., Eurocentric focus of Western Social Theory (premodern societies embed the lifeway in society, don't have secular history, therefore can't be rationally studied, hence can't be understood by Western social science until they acculturate! Jürgen Habermas (1987)

critiques functionalism & Marxism for this (like Wolf and the "people without history", Western social scientists adopt the Marxist perspective that non-Western history only begins with the spread of Western Capitalism, i.e., Balinese history begins with the Dutch arrival!. That, of course, is nonsense, hence Habermas' "post-modernist" objection to Lévi-Strauss' "cold" (reversible or cyclical time) and "hot" (linear, evolutionary time) societies; in their interlocking cycles of time that embraces **synchronicity**, the relationship between various natural (the lunar synodic period, the maturing and flowering of rice, and social time, they have a

"biological" view of time not a Western (Marxist) "industrial" view of time! (p.12) whereby "nature" becomes a "museum of the past" stratigraphically superceded by later cumulative evolution (à la Lyell); the Balinese focus on managing the productivity of nature, not mining it as a "storehouse" of raw materials as we do.

The "Hydraulic Hypothesis" & "Oriental Despotism"

Karl Marx (@1910) & Karl Wittfogel (1957) argued Bali was classic "Oriental Despotism" whereby the power of Asian kings derived from their control over irrigation. Since they abused their subjects by heavy taxation thanks to that "hydraulic" control, the Dutch could "save" them by invading and making Bali a part of their "modern" colonial empire!

=**the moral justification for Empire (and the opium trade)!** so much for paternalism & the "white man's burden"!

Income to Which No Tears Are Attached"

The Dutch scholars wrote about the irrigation system because it was like their own culture; ignored the Opium trade; the Government's imposition of an Opium Monopoly on Bali was the reason for the invasion, **2nd** biggest source of income after rice, and after conquest

of the last king, the **1st** source of colonial income, **but** no colonial official wrote about it; in contrast, lots of writing on rice irrigation! Replaced sales thru local traders to direct monopoly sales-the first building to go up after conquest was the opium monopoly administrative building!

Part of Colonialism=create peripheral dependency via delocalization whereby the colony produces (1.) raw materials & products (often "narcotic foods") sent to the central colonial power, (2.) a captive market for the colonial power's manufacturing capacity

Largely a product of the 19th cen. capitalism + disparity in military power due to advances in Western military tech. (smokeless powder, repeating carbines & gatling guns + mobile field artillery; Dutch were one of the last.

But diffusion & "cultural hybrid vigor" result: rikstaffel ("rice table") in cuisine & Dutch-Indonesian furniture, for example.

Marxism as 19th cen. Unilineal Evolutionism

Karl Marx was an admirer of Darwin & as Basalla mentions, called for an evolutionary history of technology without "Great Men", i.e., "Titular Inventors"; a 19th cen. gaslight unilineal theory that borrowed much from the early American anthropologist Lewis Henry Morgan & his emphasis on role of subsistence types in human evolution. Like all of his age, he uses the "mechanical metaphor" for society "social masses", "social forces", "social inertia", etc.

Modified the Hegelian dialectic: 1.) thesis, (2.) antithesis, (3.) synthesis, by getting rid of spirit & just concentrating on material conditions, i.e., economics.

Lansing's criticism's of Marx: Marx believed Oriental societies **static** because:

- a.) no labor cooperation beyond the village (wrong)
- b.) control of water by hydraulic state power (wrong)
- c.) religion is just camp-follower of techno-economy, that is, passive superstructure, not productive infrastructure="an opiate of the masses", used to justify class oppression and stratification.

-Good example of the ethnographic data limitations of 19th century armchair anthropology & the philosophers, like Marx, that used its data, e.g., "primitive matriarchy" from Bachofen.

Temple of the Crater Lake=the only center that is not vacant; the most important

The higher one goes in the system, the greater the collectivity; like Puebloan irrigation, solves the "control" problem by having people clear canals from the bottom up! If one did it from the top-down, then one would need control hydraulic officers to enforce continued participation since people and local groups would drop out as their canals were reached

Rice Goddess' home=Temple of the Crater Lake/local deity of the weir

Regional Water Temples=vacant ceremonial centers (also a characteristic of Central and South Amerindian states, where settlement pattern was similarly dispersed + religion played a large role in technology & society).

- a hierarchy of temples, each subak pertains to an Upper Temple and a Lower Sub-Temple (e.g., Ulun Swi/Masceti)

Hierarchy of the Gods corresponds to hierarchy of the temples

-only powerful nature gods, deities of the land and sea, are worshipped at the higher temples/ancestors at the lower temples (note the importance of unilinear kin groups in this kind of technology)

"Temple Interdependency"-lower temple requests water from upper temples,="mingling of the waters" of local temple with village temple

Upstream Water=Life-giving/Downstream water=carry pollution away, leads to "interdependency", as in "blessing"/"purification"

Bedugul=the little upstream corner of the saweh where the water first enters has a shrine (this is the lowest level in the hierarchy)

Weir=no dams, that would constrain nature, stops process/therefore, have only weirs=diversionary dams, where water is channeled by opening & closing a stoppage

Clifford Geertz (Negara: the Theatre State 1980) argued that kings had very little to do with control of water since the irrigation system **cross-cut** the petty kingdoms like Klungklung rather than **coinciding** with them. The state serves a primarily ceremonial role emulating the theocratic kings of Indian classical Hindu literature! This political emulation of religion and the role of art in the formation of the state were completely beyond Western materialistic comprehension. There were about a dozen of these kingdoms, each divided into tiny semi-autonomous principalities ruled by princelings. The number & boundaries of these were always changing via war, marital alliance, etc., but the major agricultural rites ignored these ephemeral boundaries & concentrated on the natural drainages.

**Whole Landscapes** must be the ultimate level of analysis, not small plots thereof as the inductivist Western tradition had it.

Gender Alternation (1.) Mountain lakes & in-dwelling goddess at top of hierarchy, (2.) lower-down dams, weirs and canals controlled by masculine gods, (3.) lower-still markets controlled by the Rice Goddess, and (4.), lower still, the plague-producing Demons of the sea watery depths=males!

Note: the masculine secular kingdom authority **inverted** that system!

**Subaks**=cooperatives of a 100 farmers who get their water from a common source like a main canal. They were famous for their efficiency in the Western (Dutch=who appreciated water control for obvious reasons) literature, which only concentrated on this lowest level of the system and thus completely missed the "water temples" which coordinated whole regions! This was why water temples were not mentioned in the scholarly literature on Bali! (p.3) As many as a 100 subaks might get their water from a single river.

Supernatural Technology (miracles are the "mythic empiricism" of faith; e.g., the spring of the temple by the volcanic eruptions that flowed all around it in the film. Supernatural Tech has two aspects as a "theory of work":

Technology as (01.) an "object of worship", and (02.) a "means to worship"

Rites (include 2 types):

Ceremonial Ergalogy/Ritual Technology

**Techne**=(long "E") comes from the Greek for the labors of the smith & other craftsmen who were conceived of as solitary figures (Heroic) whose techne was a jealously guarded secret connecting them to the powers of the Underworld thru the god Hephaestus. Hence secret god-directed **rituals**. In contrast,

**Erga**=was the public and cooperative work of agriculture (tillage), involving most of the gods. Fishing is the erga of the sea; honey the erga of bees, etc. Hence agricultural rites are **ceremonies**.

Georges Condominas's concept of **ritual (actually, in my sense ceremonial) technology** ("We have Eaten the Forest"), Montagnards of central highlands of Vietnam. Agriculture, as **material** techniques is not separate from "useless" **ideological** agricultural ceremonies. Rather, the ceremonies are "performative", they call forth certain social groups to engage in agricultural labor such as planting or harvesting. Thus agriculture is social as well as technical "agricultural work is not merely a sequence of technical tasks; it is a meaningful series of

interactions between social groups and the natural world" (p.6). Also, ceremony & ritual are "archival" (my term); they encode technical knowledge in a correct sequence independent of texts.

Ceremony=**sociogenic** (p.15), calls up or marshalls social groups; unlike Durkheim who suggested that ritual & ceremony merely reflects the social order, they can also provide competing models (p.16) of that social order, i.e., the difference between Balinese kingship & Priestly authority (the latter surviving Dutch rule, the former not).

@1799 Collapse of the Dutch East India Company (mercantilism)

@1850 Dutch conquest of north Bali, elevate biggest of southern kingdoms into an "empire", sign a treaty with the "Emperor" of Klungklung (note: the Dutch turn the Balinese into a mirror image of the Dutch royal state!)

1904-1908 Despite treaties, the Dutch invade south Bali & one by one the rajas commit suicide ending in the massacre at Klungklung; army puts up memorials!

1938 Dutch reconstituted the "traditional" 8 kingdoms at the temple of Besakih at galungan, the time when the spirits of the ancestors are thought to descend to the temples, **but** kings traditionally were not crowned at Besakih, or any other temple, but in their **palaces**, hence they were "colonial fetishes" for control, for above each "king" was a Dutch colonial official, a "Controller", **the colonial creation of secular power**; again, secular like themselves (mirror imaging)

### **Precocious-Canonical Tech.**

e.g., the example of the forward-swept wings, experimented with since the earliest days of the airplane jet engine, the latter days of WWII. The Germans were precocious, both in jets, and in forward-swept wings that promised increased maneuverability, but at the fatal price of uncontrollability.

1944 The German Junkers 287 jet bomber introduces forward-swept wings, but is a technical failure due to a propensity to crash

1980 The development of computers and fly-by-wire control surfaces allowed the Grumman Aircraft Corp. to design the experimental X-29 for the US Air Force.

1990 Advances in avionics due to increasing computer power make the forward-swept wing canonical in the new tactical fighters competing for the next generation air superiority fighter.

e.g., the Electronic Instrument:

1897 A.D.-Thaddeus Cahill-"dynaphone" or "telharmony"-geared shafts & induction to produce alternating current of dif. audio freq.-telephone receivers served as speakers, hence name, 1906 produced cost \$200,000, 6 feet long!

1960 A.D.-Shockley, transistor

1964 A.D.-Robert Moog-"synthesizer" transistor voltage-controlled oscillator amplifier for composer Herbert Deutsch

### **Tyranny in Tech.**

The Role of "Tyranny" in Technology, i.e., a tyrant in absolute control of a totalitarian state, e.g., Hitler in Germany, exaggerates both the successes and the failures of technological innovation.

### **Industrial Espionage**

The Role of "Espionage" and "Copying" in the diffusion of technology (very prominent in military technology), e.g., Soviet Union and Communist China.

Homer Barnett:

Invention=new principle, i.e., gunpowder

Innovation=new form, function or significance

Novelty=new form, function or significance, but addresses **no known problem** like self-levelling putter

Technological Atavism=Chinese flaming fire lance, or early bombards shooting arrows like earlier ballista

Technological Prototype

Skeuomorphism=negating new "inherent perfectability of form" (foresight)

to simply do an old thing better (hindsight), e.g., vinyl "wooden"

dashboard, or Basalla's pot with cord handle=> modeled ceramic handle

in Africa

"Naturfact Analogy", **barbed wire**, even if no machine analog exists, can model from nature. In American west no trees, therefore wood for fencing expensive, no stone, so can't build stone walls. Therefore used thorny tree, the "**Osage Orange**" for hedgerows. First armored fence emulated it, called a "thorny fence", but was superseded by the DeKalb Illinois county fair inventors (2 competing factories), on edge of prairie, 1874

"Bio-mimetic Technology"-Bio-mimesis mimics, or takes inspiration from, natural **ethology**, **not morphology** (that was "naturefact analogy"), as in modern small autonomously powered tiny remote battlefield drones designed to fly like insects, whose flight anomalies have only recently been understood (the paradox of the flying bumblebee, which, according to classical aerodynamics, should not be able to fly at all!

"Technological Maturity" 1st ex. of new tech will always be defeated by perfected ex. of archaic tech. (old principle)  
e.g., longbow will out-perform early hand canon

-so, sign on to new tech **as an act of faith**

Tech Maturity produces=

"Technological Conservatism" (English; late to gun because they relied on their fabled longbowmen)

"Technological Survivals"=modern men's neck tie

Culture Lag=ceramic topia when migrated to stone-rich Caribbean

"Atavistic Technology"

-1908 A.D.-E.P. Caldwell-4 cycle engine-2 wheels under it put in front of carriage like horse, "mobile horse," "iron horse," "gasoline horse"

-"Quadracycle", what Ford called it, from bicycle

"Successor-Induced Hypertrophy"

**Homo ludens not Homo faber**

Technological Dreams ("Dream Tech."), "technologist's propensity to go beyond what is technically feasible

**Technological Extrapolations**, a step or 2 beyond only

1400-1600 the "machine books" of the "Theatre of Machines"

like Agostino Ramelli's (French military engineer)

Toy-sketch or model-upscale-prototype-production unit

"Upscaling"

1.) Increased Mass

2.) Multiplied Elements

3.) Added Manpower

4.) Materials Science Solution (increases "ceiling" of Design

Optimization, leads to "cascading" design reductions)

Initial effort to get around materials science limitations is "over-building",

or "Brute Force Technology", result it stands the test of time  
Successful borrowing from long-distance prestige trade, in the case of  
gunpowder this is the **silk trade**

Why was Europe successful? Had the correct "cultural context"

1.) the **enabling technology**

a.) blacksmithing (indigenous, esoteric tech.)=sacred

b.) alchemy, which provided the chemistry

c.) that means you only needed the **formula**, by the only literate  
people around, the monks=Roger Bacon

2.) **cultural congruence** in social organization (squabbling, competitive  
feudatories, which kings needed to centralize by blowing up the  
castles)

3.) **ideological congruence** (new tech is good, **technological  
intoxication**)-the revolution in machine tech. by late middle  
ages

1.) Bellows

2.) Gunpowder

3.) Crank

4.) Gears

5.) Mold-board plow

6.) Stirrups & pommeled saddle

7.) Keel & Lanteen sails

Notes on Bates & Plog, ANT 222

Adaptation

biological species

carrying capacity

cultural relativism

ecology

ecosystem equilibrium

ethnography

evolutionary ecology

evolution fossils

genetics

habitat

holism

homo sapiens

horticulture

hunting and gathering

industrialism

intensive agriculture  
natural selection  
niche  
pastoralism  
resilience  
stability

Chapter 6-Bates & Plog:

Culture of Poverty

Leslie White (1949)-Fuel Age

Specialization

Homogenization-"World Culture"

Demographic Transition

Europe 1650-1800 grew from 100 to 187 million

Europe 1800-1900, Coal Age 187 million to 400 million-today  
doubling every 35 yrs; El Salvador-45 per 1000

Matrifocal

Mechanization

Industrialization

## Middle Ages

120 B.C.-Toe stirrup in India

100 B.C.-Ball bearings in Europe-tech. experimentation

100 A.D.-Paper in China

378 A.D.-Emperor Valens loses to Fritigen's Goths at Adrianople

477 A.D.-Stirrup in China

520 A.D.-Triangular lateen sails & big keels on Western ships

600 A.D.-Seigneur & vassalage (Feudalism)

694 A.D.-Arabs get stirrup from Persians

732 A.D.-Battle of Poitiers-Charles Martel & Stirrup, heavy cavalry routes Moors

757 A.D.-Byzantine Greek Emperor sends pipe organ to Pepin the Short

816 A.D.-Pipe Organ, man-powered bellows, crank=twice-bent lever, appears in Utrecht Psalter

950 A.D.-Hurdy-Gurdy in Europe

950 A.D.-Vertical axis windmill in Persia

960 A.D.-Motte (enclosure) & Bailey (keep) becomes chateau

980 A.D.-Elfeg, Bishop of Winchester, commissions 1st monster organ=70 men pumping 26 bellows for 400 pipes

990 A.D.-1st use of water power for smithy (bellows) + water power for fulling cloth, a step in fabric manufacturing

1010 A.D.-English monk builds glider

1185 A.D.-Horizontal axle windmill

1242 A.D.-English Friar Roger Bacon describes gunpowder

1250 A.D.-Fan escapements, 120 water mills near Ypres, Flanders

1320 A.D.-First bombards (bottle-shaped, shooting big bolts) & cannon (tubes) pictured. Canon already known earlier.

1350 A.D.-By this date Europe surpasses China in Tech.

1384 A.D.-Bellows got big enough at Liege, Flanders, to produce high temperatures to cast iron in 1st known blast furnace (cast iron)

1420 A.D.-Shoulder-fired "hand canon" in widespread use-uses the "touch hole" system.

1450 A.D.-Iron canonballs replace stones; French artillery train blasts English out of their castles in Normandy & ends 100 years war

1470 A.D.-Matchlock in use ("arquebus"). Uses a "serpentine" to arc taper into the flash pan loaded with a finer grade of gun powder

1515 A.D.-Battle of Marignano, Swiss Pikemen (18 ft. pikes) stopped by artillery

1517 A.D.-Wheellock introduced, Johann Keifuss of Nurenburg invents, uses iron pyrite rather than flint; now cavalry has gun

1534 A.D.-Spanish invent the *tercio*, 3,000 man pike & arquebus, they led the way for the arquebus, wanting to reincarnate the Roman legion

1540 A.D.-"Corning" of gunpowder (makes it coarser, better burn)

1550 A.D.-Snaphouse lock is invented, simpler

1610 A.D.-Flintlock invented by Marin le Bourgeois King Louis the 13th

1631 A.D.-Swedish King Gustavus Adolphus, lèvee en masse, retained from Middle Ages-had been abandoned on continent, defeats imperial general Tilly, battle of Breitenfeld

1752 A.D.-Frederick the Great of Prussia, 50 % of budget to war

1795 A.D.-Napoleon rises to power, using field guns in the streets to suppress mobs

1807 A.D.-Scottish Presbetyrian minister Forsyth, an avid fowler, invents percussion lock, as amateur chemist, invents a "fulminate"

1841 A.D.-von Dreyse breech-loading needle gun (Prussia) 1st gun with firing pin

1858 A.D.-Smith & Wesson invent 1st practical self-contained cartridge, a rim-fire (too small in calibre); then the center-fire

1860 A.D.-The Henry Repeating carbine, successor of the Volcanic Arms invention and predecessor to the Winchester (USA)

# Tech. in China

Mark Elvin="High-Level Equilibrium Trap"

a.) Very Intensive Farming

b.) Complete Transportation Network (roads & waterways)

c.) Low per capita income

1,500 B.C.= Bronze Casting + Kaolin & Feldspathic Glazes

850 B.C.= White Iron (not grey of west) high carbon content reduces melting point; otherwise not melted in the west until the

19th cen. This ore also has a high phosphorous content, hence it is brittle and biased toward casting

800 B.C.=Stack casting is innovated, filling a dozen molds at the same time for small, flat pieces like coins, harness buckles;

a possible production line forms first true factory: (1.) an open smelter with bellows, (2.) stacked molds, (3.) separate

kilns. This is 1/2 of industrial revolution: mass production

300 B.C.=Cast Iron Plow Tips, hence could break more land

202 B.C.=Foundation of Han Dynasty; the parallel to Rome; building standards for structures begin to be enacted as part of

Wang An-Shih's reforms to rationalize administrative expenditures

200 B.C.=Double-action Piston Bellows are in use; very effective for metallurgy because they allow a continuous jet of air

220 A.D.=The Han Dynasty falls, China fragments into petty kingdoms

100 A.D.=Paper is invented

450 A.D.=Steel is in use

589 A.D.=Paddle-wheel Boats are cited

600 A.D.=T'ang Dynasty, openness to west via the silk road, Gunpowder invented

648 A.D.=Ch'ang An, is the 1st grid city layout (making it the 1st example of true city planning); it has a population of 1 million and measures 5X6 Square Miles

750 A.D.=Xylography (Wood Block Printing) Invented/Western Typography (5,000 Chinese Characters)

900 A.D.=Coal used in smelting

953 A.D.=Confucian classics printed in 130 volumes, sparks a renaissance

1000 A.D.=Sung Dynasty, ships have bulkheads, Mines & Hand Grenades Developed. This partially compensated for the Sung lack of cavalry against nomads.

1024 A.D.=Paper money in use

1091 A.D.=Building Standards are Codified in Li Chieh's 1,078 page work. Bracket arm assemblies have 43 carved pieces, not counting the lintels. White cedar has 4X the tensile strength of steel!

1100 A.D.=High point in population, then falls causing labor shortages. This leads to water-powered machine for spinning hemp for rope.

1119 A.D.=Magnetic Compass is in use

1200 A.D.=Gunpowder goes west with Chinese traveling in Mongol Empire

1221 A.D.=Movable type in use for block-printing

1242 A.D.-English Friar Roger Bacon describes gunpowder.

1250 A.D.=Southern Sung Dynasty; explosive bombs fired from catapults are used against invading Mongols

1270 A.D.=Mongols conquer all of China

1350 A.D.=By this date Europe surpasses China in technology

1354 A.D.-Traditional date for the German monk Berthold Schwartz to "invent" gunpowder.

1368 A.D.=Ming Dynasty retakes China from the Mongols, but are conservative & xenophobic as a reaction.

1371 A.D.=First ironclad ships appear (their prows are sheathed in iron); population is recovering

1403 A.D.=Koreans using cast metal type, but in China it never replaces xylography-by this date there are still more printed pages using xylography in the east than there are printed pages using typography in the West!

1414 A.D.=Ming use portable canon in punitive expeditions against Tartars.

1446 A.D.=In west, the first practical canon ("bombards") appear, but they are clumsy & shoot stone canon balls.

1540 A.D.=In west, the "corning" of gunpowder is invented. This coarsens gunpowder, allowing it to burn quicker & more effectively.

1600 A.D.=Late Ming (continuing on into Manchu Dynasty) employs western canon cast for them by Jesuits.

1650 A.D.=With crops from New World pop. grows to new high point. This is the time of the "High-Level Equilibrium Trap"

1662 A.D.=Manchus take China; Market Towns grow faster than pop., thus inhibiting adoption of new technology

1741 A.D.=From this date to 1770 Britain triples cotton production

1750 A.D.=The elite mounted archers/lancers, the Manchu Bannermen, are militarily paramount until around this date, threatened by

guns in the hands of Chinese insurgents

1757 A.D.=Muskets authorized by Manchus to protect grain ships on great canal from Chinese bandits

1785 A.D.=An illustration of "High-Level Trap:" in this year a single province of China, Kwangtung, imports 6X as much cotton from India as Britain uses

1850 A.D.=China's population is now 400 million

1870 A.D.=Kwangtung's silk machines are now steam-powered, inspired by French in Annam (Vietnam), but in a form of "Oriental Ludditism," 600 factory workers rebell

# Tech. in Japan

1543 A.D.=Portuguese land with 2 arquebuses in Tanegashima  
-Japanese so impressed, they are bought on the spot!

1560 A.D.=Oda Nobunaga uses coordinated sequences of matchlock firing to decimate cavalry charges

1575 A.D.=Oda Nobunaga now triumphant using gun at battle of Nagashino

1590 A.D.=the commoner general Hideyoshi unifies all Japan after 2.5 centuries of feudal disunity

1591 A.D.=He rigidifies class structure

1597 A.D.=Hideyoshi throws out the Portuguese missionaries and launches the 2nd Korean invasion, the "Pottery Wars" from whence come the kidnapped Onda potters

1600 A.D.=The Battle of Sekigahara where Ieyasu wins decisively

1603 A.D.=Ieyasu Tokugawa founds the Bakufu, or "Tent Government" and is named Shogun. He used canon to batter down resisting Daimyo's castles.

1638 A.D.=Hidetada, the 2nd Shogun, quells the Shimabara Peninsula uprising, crushing the Christians

1641 A.D.=The Dutch are quarantined in Deshima island in port of Nagasaki

1643 A.D.=An ordinance limits local lords to silk pongee, hemp & cotton, "sumptuary laws," and the military technology comes to a full stop; shokunin (craftsmen) segregate from other laborers

1720 A.D.=From this time on "Dutch learning" flourishes surreptitiously

1853 A.D.=Admiral Perry forces ports open with the "Black Fleet"

1867 A.D.=Meat is advertised for the 1st time (as "Mountain Whale")

1868 A.D.=The Meiji Era begins

1869 A.D.=The 1st rickshaw factory opens

1872 A.D.=The "period of Intoxication" begins and foreign dress has to be proscribed from ceremonies, The 1st train appears

1882 A.D.=The Rickshaw is exported to Hong Kong and Singapore

1884 A.D.="The Improvement of the Japanese Race" is published by Takahashi Yoshio; but the battle is joined marking the end of the "Period of Intoxication" with the publication of Sada Kaiseki's "On Lamps As A National Disaster" (Western gas lamps versus the traditional paper lanterns, "andon")

1890 A.D.="Kogaku" Academy of National Learning founded, the indigenist-nationalist reaction

1894 A.D.=The "unequal Treaties" are renegotiated successfully

1903 A.D.=The train opens in Tokyo, the death knell of rickshaw; it still survives in Hong Kong and Singapore

1907 A.D.=Sea Battle where Admiral Togo defeats the Russian "White Fleet" and Japan thus defeats a major, albeit 2nd rank, European power

1950 A.D.=Rickshaw outlawed in Hong Kong, remains in Singapore

## The Old & the New

"Intermittant Duration" Tech.=Basalla notes sword as Kubler's idea of intermittant tech., an item that appears, then disappears then reappears, either at a later time in the original area or hangs on in a peripheral area, eg., steam trains in China

"Battleship Curves" & relative chronology from typological seriation

### 4 Types of Intermittant Tech.

- 1.) Technological Archaism as "nostalgic affect"
- 2.) Retro-tech (artifacts that do not pretend, such as bakelite phonos that are touch-tone, altho they look like rotary)
- 3.) Age-area Archaic tech., the steam trains in China because they have lots of coal, not alot of oil + the tech. is easier to master
- 4.) Old Fashioned Tech., or tech. Simplification (Germany sells deisel sub tech to China, China then sells that tech. to Iraq) or "Long March" Russian SSTs in China for sale to Iraq; "exotic affect"

## Notes on Lemonnier

### French School

Social bias (Napoleonic Code) critiques Anglo-Americans for their concern with individuals

### French Marxism

French Cartesian Dyads (function/style)

Mauss, Marcel, "Les Techniques du Corps" (1935)

Leroi-Gourhan, Evolution et Techniques (1943, 1945) "tendency" & "fact"

(an archaeologist, a taxonomy of percussion)

Gille, Histoire des Techniques (1978), metallurgy, "bottlenecks" (historian)

CNRS (Centre National d'Research Scientifique ?)

"operational chain" (as get to branches becomes stylistic)

but critique that, buying in to the basic system is also stylistic

Langimar (can sketch dead-fall trap, don't use

Driver & Massey (1957)-maps & culture areas based on artifact types

"First operating artifact freezes the genus"

Cessna C137 "Skymaster" (boom-twin rudder, push/pull=not macho)= "social representation"

"arbitrariness"

burning-planting-barrier (can be switched around)

## **EVOLUTION IN TECHNOLOGY** **(Notes on Basalla)**

Diversity=far beyond necessity

Necessity=not really, rather "a perceived need", "the good life";i.e., cultural

Aristotle, who wrote extensively on biology, made little use of mechanical metaphors; not until the Renaissance did mechanics intrude on nature (**automata**)

Not until Evolution with Charles Darwin's **Origin of Species**, 1859, and

**Herbert Spencer** did metaphors from biology intrude on mechanics!

a.) from **simple** to **complex** in form (problem of no teleology)

b.) from the **generalized** to the **specialized** in function in both realms

Continuity (Traditions, Canonical Tech.)/Discontinuity (Precocious Tech.)

Basalla opts for continuity:

Eli Whitney and the Cotton Gin:

1.) before his trip to the south in 1793 the staple crops were rice &

indigo

James Watt & the Steam Engine:

1.) the popular legend that he dreamed of the idea by watching a tea kettle steam! comes from his genius unaided.-1775

2.) But, the atmospheric Newcomen steam engine was current all over England since its invention in 1712!

1.5 million species/4.7 million patents since 1790

mid-19th century in England-500 types of hammers

traditional folk explanations of technical diversity were based on:

a.) necessity, as in Aesop's Fable of the Crow (can't drink from a tall

jar until throws pebbles in to raise the water level à la

Archimedes=Folk model of necessity

b.) utility, utilitarian items necessary for survival, like clothing-but

cite the Fuegian example where clothing not necessary!

Case Study: the Car, made possible by Nikolaus A. Otto's 1876 invention

of the 4-stroke internal combustion engine; this did not take

place in response to a world-wide horse epidemic! In fact, during the 1st decade of its existence (1895 Daimler-Benz-1905), the auto was a toy of the well-to-do; the truck took even longer, not until WWI.

Case Study: the Wheel (ethnocentrically regarded as one of the 2 greatest inventions: fire and the wheel. But fire is at least 1.5 million, the wheel only 5,000 yrs.old. No proto-type in nature, perhaps inspired by log rollers. Wheels made appearance @3,500 B.C. in the Eurasiatic steppes somewhere between the Tigris-Euphrates & the Rhine (he says Mesopotamia, but wasn't), single or 3-piece versions.

1st were for ceremonial purposes (burial with dead, god-carts & war).

4 wheeled "battle wagons" & "straddle-car" (chariot precursor) used in Middle East & Egypt to hurl javelins from. By 2375 B.C. carts are documented to haul produce, at the same time wagons show up further east in India, at 1,500 B.C., later still, in China. By that time chariots with spoked wheels appear in the Middle East.

Most of the world did quite well without wheel-- Southeast Asia,

Africa south of Sahara, Australia & Oceania and all of the New World. Best case of a "civilization" without the wheel, for Europeans

regarded the wheel as an indicator of civilization, was Mesoamerica

with wheeled toys from 300-1500 A.D. (no draft animals).

Moreover, some areas had it, then **rejected it!** The Near East from 250-650 A.D. adopted the camel (more water-use efficient than an ox and a cart-pack animals ignored by Europeans); it wasn't until the coming of the Europeans that the wheel returned! By 19th century Euro-American scholars elevated the wheel to 2nd place. Not

a "universal necessity" but a Western ethno-centric preoccupation.

"Animalistic" Argument=His argument that on a zoological level we could live like the animals-without tools is wrong, as is his discounting of

animal tool use as too simple to compare, or provide the evolutionary background to, human tool use.

José Ortega y Gasset=technology is the "production of the superfluous"

## "Ages" of Technology

pre-1350 ="Archaeotechnic" (Roe), Play tech like Hero's aeolipile

1350 A.D.="Eotechnic" (Mumford, 1934), a wood & water technology

Clock

Organ

Wind & Water Mills

Printing Press

Blast Furnace

1750 A.D.="Paleotechnic" (Mumford, 1934)

Steam Engine, James Watt, 1765 beginning of the industrial revolution

Murdock's Steam Carriage

Cort's Reverbatory Furnace

Wilkinson's Iron Boat

Cartwright's Power Loom

Jouffroy & Fitch's Steamboat, later with screw propeller

1850 A.D.=Neotechnic (Electricity & Alloys)

Fourneyron's Water Turbine

Faraday's work on electro-magnetic current, the dynamo

1920s in USA, telephone, wireless, roads, cars, airplanes

\*\*\*\*\*

All above were ages of materials, all below are ages of information

\*\*\*\*\*

1950 A.D.=Holotechnic (Roe, from the Greek="Complete") atom, plastic & composite technology

1930 precocious, Aiken's IBM electromechanical computer

1943 England's "colossus" electronic computer, enigma code

Shockley & transistor

TV & Computers

Daniel Bell (1956) and "service economy"

Eric Larson (1986) and "finite element engineering"

-Based on consumption, not production

-measured in kilograms not dollars

a.) kilograms divided by population=consumption per capita

b.) kilograms divided by significance of materials in economy as a whole

e.g., 1976 Caprice Classic 2,007 kg (4,424 lbs)

1986 1,617 kg. (3,564 lbs.) 390 kg. less

Steel declines in 50s, what it was 100 yrs ago (40% decline from 20s peak)

## NOTES ON THE "ZIPPER"

- It is often the 1st "machine" one encounters as a child
- Considered one of the notable inventions of our age (Tech. fair in Germany)
- Friedel asks, "what do common, everyday artifacts reveal about ourselves?"
- Tech cannot be explained by simplistic causality alone, such as "need" ("necessity"), "demand" or "function"; he is not a tech. determinist
- Rather, cultural causality, such as the need for novelty in American culture, is important
- Ergo, the patent act of 1836, enthusiasm as profit motive; 40,000 per anum in the 1890s, a vertiable "technological infatuation" like Meiji Japan!
- Emphasis on Faith, people must buy into it, both as inventor, as investors and as the public (consumers)
- but, culture can deny it, as in our mistaken dependency upon "necessity" (the apocryphal story that Judson, a big man, had trouble tying his laces!; "folk" "emic" models may be misleading)
- 1893 Chicago World's Fair (Scientific American & its entrepreurial interest in patents), Whitcomb L. Judson patents for a shoe fastener
- Judson wanted to be the "inventor as hero"; this was the age of Alexander Graham Bell (1876) and Thomas Edison (filament 1880); he started out as a traveling salesman for ag. machinery
- Judson was the classic "yankee tinkerer"; his "perchant for complex mechanisms" & "mechanical cleverness"--he met problems by piling complexity upon complexity; in love with tech.
- His enfatuation with pneumatic (like Basalla's "atmospheric") streetcar (tech. fad, can't work, slit in top not sealed by leather)
- Harry Earle (another farm machinery salesman from the same company) He is the "promoter", the hustler that keeps Judson's invention alive
- "Universal Fastener Company" & corsets, a real problem of the age
- the tie of fasteners with carpentry as a "Western style in tech."
- "Play" in tech., look at the varieties of the "zipper"
  - 1.) 1891, 1st, "guide" (the essence of the zipper) and clasps"
  - 2.) 1893, the "improvement", "tech. atavism", copied hook & eye
  - 3.) 1896, guide + nesting hooks & eyes
- "Precocious Technology"-----
  - 4.) 1905, "C-Curity", Judson's final design, everything but secure! Has hooks on one side, eyes on other
- the "Government crutch", "if new tech has:
  - 1.) uncertain markets
  - 2.) large capital requirements

3.) technological challenges yet to be overcome

=sell to the government! (in this case as Mail Bags)

-9 million immigrants in 1st 10 yrs of 20th cen.! (tech. transfer-voluntary)

an example is:

-Peter Aronson, Swedish mechanic, export connection to Europe, his daughter Elvira attracted Sundback, then died in childbirth (the role of historical contingency!

-Gideon Sundback, another Swede, but trained in Germany (lovers of complex tech and therefore early adopters of the zipper. He leaves Westinghouse for the zipper; He is the one who perfected the zipper going to:

-1908, the Plako fastener, his 1st attempt, a new eye + flexible backing (innovation)

-Willie Wear, the fast-talking salesman, "pioneering entrepreneurship", never go back to old sales territory

-5 carat diamond ring, eventually abandoned by Walker

-Hoboken, NJ (Aronson runs)

-Tech. difficulties:

1.) had to remove fastener to wash; rusted

2.) still unzips involuntarily

-----Canonical Technology-----

-Lewis Walker, the "Colonel", the 1st college grad & modern man, canonical manager

-moves to Meadville, PA; the perfected Hookless fastener, Sundback's true "invention"

-Simultaneous invention (the two other patents, Swiss & American)

-1920s, the zipper successful, why? "roaring twenties" casualness after WW1

-YKK & the Japanese; early were reluctant to export to Japan because they heard they copy everything, sure enough, YKK forces Talon Inc. out -yet another case of American Invention/Japanese Perfection

-2001=the world's largest zipper, the head itself more than a foot long, has been proposed as the joining device to put together huge bags of fresh water to transport them thru salt water (the oceans) cheaply to areas, like islands, that require additional freshwater sources, often for tourism. It will undergo trials in Manhattan harbor.

Modern "Technological Chaos"

Modern "throw-away" society based on 1.) black box, (2.) increasing info-tech. improvements=obsolescence, (3.) lack of support, (4.) fragility of "finite element engineering"

Airbus=1st plane to leapfrog prototype stage via info tech & CAD/CAM

design

**Technological Unemployment, e.g., linotype industry; moves labor from manufacturing to service at cost of increased education requirements**

**"H.I.T."="Hobbled Intentionally Technically",**

**01.) for commercial reasons, e.g., MiniDisc**

**02.) for entertainment reasons, e.g., recumbant bikes outlawed in racing**

**03.) for security reasons, e.g., G.P.S. or the overlay map of NYC**

**04.) for religious reasons, e.g.,**

**How do you get from precocious tech. to canonical tech.?**

**01.) technical push=government may boost tech. out of "chicken or the egg" problem (no market, therefore expensive, therefore non-competitive), as in California mandates for clean vehicles lead to hybrids (Honda & Toyota)**

**02.) market pull=becomes profitable, hence adopted rapidly by market**

**- "Age of the Foreseeable": by the technology writer Chris O'Malley=The mantra of the age: "If you can dream it, you can build it" results in tech. that is mere novelty, i.e., doesn't work well. Two easy questions are ignored: (1.) will it work?, (2.) will people pay for it?, or, is it affordable?**

**- "Technological Chaos"= The result is that we live in a world of the chaos of competing and doomed systems. Companies that only seek to be first in the market place to produce unproven or non-workable tech. set themselves up for bankruptcy and consumers for inconvenience & financial loss, e.g.,**

**-Iridium (a satellite phone company with a great idea-use your phone anywhere on earth and on airplanes); it failed because its phones were too bulky, too expensive [\$1,000.00 or more for the phone] and didn't work inside buildings! or**

**-tablet PCs like Apple's Newton that disappeared in the 1990s because hand-writing recognition didn't work (Bill Gates recently announced that Microsoft would try again,**

**having abandoned "Pen Windows" a number of years ago-**

**-the simple keyboard is superior & now comes in miniature folding versions for PDAs); or**

**-voice recognition in computers like Dragon or Kurzweil that claim 90% accuracy or better; at even 95% every 20th word would be garbage or, to re-illustrate, a short four-line column of text would have 40-50 illegible words +**

**tedious voice-print "training" is required, or**  
**-wireless tech. is another, despite wireless computers, printers,**  
**Internet access, audio & video systems only 2 things in**  
**the home currently work on wireless tech: cordless**  
**phones & TV remotes; perhaps the recent introduction**  
**of "Bluetooth" software will make this precocious tech.**  
**canonical, as in a cover on the new Motorola Timeport**  
**270 cellphone-can use it to dial up the Internet on your**  
**portable computer or talk hands-free on a bluetooth**  
**headset; or**  
**-HDTV and DVD have come out half-baked, the first due to**  
**a dirth of programming & cost and the second without**  
**(until recently) the capacity to record--which VCRs can**  
**do at \$100.00!**

## **"Machine Dreams": Robots & Androids**

**"Emotility"=achieves human emotional social response**

**"Play Parity"=achieves human creative standards in mental life (fantasy, dreams) and in action (art & games)**

**"Aesthetic Awareness"=achieves human levels in the aesthetic or affective imperative ["stimulation"] and with regard to thresholds of boredom ["fatigue"]**

**"Self-consciousness"=achieves human self-awareness as a unique ego**

**"Intelligence"=achieves or exceeds human reasoning capacity**

**"Computational Ability"=exceeds human numerical ability**

**"Mobility"=achieves human bipedal mobility**

**"Manipulative Ability"=achieves human manipulation and sensing levels**

**"Autonomy"=achieves human independence (auto-guided/auto-powered); intelligent, self-directed characters that can move about on their own.**

---

**"Emotility" (the "C-3PO" Dream)**

**-Cynthia Breazeal, a Postdoc at MIT's Humanoid Robotics "Artificial Intelligence" Lab, and student of foremost robotics specialist Rodney Brooks, who began work with insect-like machines and then went on to physically humanoid (infantile) machines with head, torso and extremities, like "COG". "Kismet" (head only). Humanoid movable eyes, ears, mouth, head. It can see with 4 color cameras, "hear" via a microphone, and vocalize via a speaker. Computers help it measure distances and recognize and face objects. It responds to faces by looking for flesh tones and eyes (and, itself, has large eyes). It is programmed with 3 motivational drives derived from developmental psychology, complete with computer display via bar graphs of which state currently expressed. These are (1.) social [inter-action], (2.) stimulation [needs], and (3.) fatigue (boredom). It registers these drives interactively with people by making eye contact, craning its neck. "Kismet calls people toward it. And when they get too close for its cameras to see them well, it protects its personal space and pulls away. When an object suddenly appears in front of it, Kismet quickly withdraws and flashes a look of bewilderment"-Cohen 2000:109. Unlike other robots it is socially successful, people wanting to keep it happy (providing it with social stimulation and colorful toys) and worrying about its fate.**

**"Mobility"**

**-2001 Sony announces (tho without plans for production) its "Asimo" humanoid robot. The first to come close to mimicking human movement. The key: small actuators that vary the turning of the joints. The "Asimo" at 4 feet tall and 95 pounds is the size of a child;**

the smaller prototype SDR-3 is 20 inches tall and walks at 15 yards per minute. It even gets up on its own if it falls and can walk backward as well as forward & climb stairs!. Vision comes from a 1/5 inch CCD color camera. Also included are ports for PC Card and Memory Stick data storage. It is the result of 15 years of research. Sony advertisements explicitly promote it as an illustration of the "Power of Dreams" [www.world.sony.com](http://www.world.sony.com)

### "Autonomy"

Largest robot built as of 2001 that is fully autonomous & auto-powered, and without a human inside is a 11,000 pound 13 foot tall, 18 foot long "Dino". It illustrates biomimesis & dream tech. since it is made to simulate a triceratops in a dinosaur theme park when covered with realistic hide. Originated by Walt Disney Imagineering & Development, it has split to form a separate & now a private company, "Applied Minds", founded by Danny Hillis, who was a Disney Fellow after inventing massively parallel supercomputers in the 1980s.

- "Gastrobots" ("Chew-Chew", a self-powered robot which provides its own power by "eating"; it is a set of three child's wagons that form a robot, designed by Stuart Wilkinson of the University of South Florida at Tampa. 3 feet long. A plastic stomach contains *E. coli* bacteria that metabolizes sugar, releasing electrons as they break it down. A chemical derived from the Henna plant scoops up the electrons and carries them to one side of a fuel cell. They are then drawn even more strongly to oxygen atoms on the opposite side, so the electrons flow across the cell, creating a current. An esophagus vents carbon dioxide to prevent the robot from ingesting air with its food; a meal of 3 sugar cubes takes 18 hrs. to digest and provides only 15 min. of power. Robots of this type could monitor a farmer's orchards, dinging as they work, eliminating pests.

Dream Tech.=This realizes the "dream tech" paradigm: "I always wanted to build a robot dinosaur", he says (fusing the 2 dreams of the child: robots & dinosaurs). Power is onboard & comes from 55 sealed lead-acid batteries, 3 electric motors to move each of 4 legs, a Pentium 700 megahertz processor for each leg, and a central computer that receives wireless commands from a remote console, loads appropriate software from the computer's memory, and coordinates each leg's responses. A gyroscope tells the robot how much it is leaning and lasers at each ankle measure the distance to the ground to help calculate how each step should be taken. Sensors tell Dino how far each motor has rotated and the distance it has moved. Right now Dino can handle uneven ground &

walk up-hill.

**Practical Applications Come Later!** Such large autonomous robots, once developed for exhibit Dream Tech purposes can then have practical applications like fire-fighting, containing chemical or nuclear accidents, defusing land-mines & bombs and exploring outer space.

**Scalability=**The real problem is scale, increases in scale create geometrically larger increases in weight; make anything 2X as big and it gets 8X heavier; extra mass shoots up forces of momentum, the more dynamic it becomes, torque producing enormous stresses, thousands of tons, on joints so all movement must be slow & deliberate.

**Smaller Dinos will be first=**the Leg Lab group at MIT's Artificial Intelligence Laboratory is building its own much smaller bipedal walking dinosaur, "Troody", based on late cretaceous Troodon, 6 feet long & 4 feet tall (their's is even smaller at 10 lbs--it can afford to fall over--with 16 electric motors, sensors & gyroscope. Its computer reads all sensors 700 times per second. Now tethered via joystick, it still makes its own decisions. It is made for the same display purposes.

### **State-run Monopolies=Non-functional**

**-Amtrak, despite the 2000 addition of the "Acela Express", a version of France's TGV built by Bombardier in Canada at 150 mph "Since it was cobbled together from the ruins of the freight railraod's dying passenger business in 1971, Amtrak has chugged through \$23 billion in federal funds and been plagued by an entrenched bureaucracy, pork-barrel politics, high labor costs and stagnant ridership [as a result of chronic ride delays and missed connections]-all the things, in short, you might expect from a state-run monopoly"-Eisenberg 2000:62**

### **The Role of Accident in Innovation**

- "In the history of scientific and technological endeavor, there are few if any cases in which the end was exactly what was intended at the beginning. In the mid-19th century, William Perkin sought a way to make artificial quinine out of coal tar and ended up with the first aniline dye"**.
- "Alexander Graham Bell thought the telephone would be used only to inform people of the arrival of telegrams"**.
- "Alessandro Volta designed a eudiometer for exploding bad-smelling gases with electricity. It ended up as the spark plug"**.
- "A 1969 interuniversity computer network [the DARPA NET], intended as an academic exchange, ended up as www.everything".-Burke 2000:65**
- "Accidents happen: aniline dye falls into a 19th century German researcher's petri dish that contains a bacterial culture, revealing that it preferentially stains and kills certain bacteria. The discovery eventually makes chemotherapy possible"**
- "Serendipity intervenes: in the London summer of 1928, an open window in a hospital lets in a spore that settles on a staphylococcus-culture petri dish left unwashed. A mold grows and contaminates the staphylococcus. The lab user returns. Because he's bacteriologist Alexander Fleming, and because his lab has not been cleaned, penicillin is discovered".-Burke 2000:66.**

### **Innovation as Greater than Sum of Parts**

- "...novelty, by definition, must be new. Innovation [note the mixture of terms] most often occurs when ideas or things are brought together in a way that never happened before, and when such juxtaposition occurs, the result is greater than the sum of the parts. One and one make three".
- "A late 19th century engineer, Wilhelm Maybach, working for Daimler, puts together the newly invented perfume spray [nozzle] with the newly discovered gasoline and comes up with the carburetor".
- "In 1823 Scottish chemist Charles Macintosh, working with a throwaway coal tar by-product, naphtha (used to clean out dyeing vats), stumbles across the fact that it will liquefy rubber. So he spreads the rubber between layers of cloth and invents the raincoat".-Burke 2000:65

### **Innovation's Consequences are not Recognized**

**- "In 1660s Germany, Magdeburg Mayor Otto von Guericke tries to solve the riddle of a compass needle that doesn't always point (as people thought it should) at the Pole Star. He rubs a model of the earth made of sulfur in order to attract his experimental compass needle. The rubbing produces a noise and a spark (which Guericke mentions in a casual footnote) that turns out to have been electricity".-Burke 2000:66.**

### **Rates of Innovation Accelerate with Discovery of New World**

- "Until about 500 years ago, however, innovation in a world moving at the speed of agriculture came infrequently, giving time for accommodation and a complacent sense of establishment. Then Columbus re-discovered America, and suddenly the rug was pulled out from under every form of Western authority. America had figured neither in the Bible nor in Aristotle, so what was it doing there? Then, within a few decades, returning with explorers from east and west came a flood of new plant and animal species [the "Columbian Exchange"], all of them also absent from the canonical lists. Help! If Holy Writ and the Big A were wrong, which way was up?"**
- Life settled down to better than chaos only in the early 17th century, when French noodler René Descartes saved the day with a trick for thinking things through...:doubt what isn't self-evident, and reduce every problem to its simplest components. It is these twin tools of methodological doubt and reductionism [as well as the objectification of observer from nature, that produced the 19th century florescence of innovation].**
- Reductionism encouraged the fragmentation of knowledge under the rubric 'Learn more and more about less and less'. And as the drive to subdivide the natural world [the death of "Natural History" by the early 20th century] into smaller and smaller bits brought the development of the kind of tools needed for this enterprise (microscopes, telescopes, thermometers, dividing engines and all the other instrumentation required for measuring the new data), disciplines split into subdisciplines and sub-subdisciplines...niche expertise [and specialist innovation resulted].**
- Since WWII this is beginning to be reversed. "Now and again, deep in the epistemological woodwork, mind-numbingly arcane fields mix and mingle to produce cosmic upheaval with startling new realms of crossbred knowledge: astrophysics, biogeography, psychopharmacology, neurochemistry, paleobotany"-Burke 2000:66**

### **Unanticipated Negative Consequences**

**-"James Watt's steam engine generated an industrial revolution that gave us a democracy of possessions-and over-population, acid rain, the Love Canal, disappearing forests, tattered ozone layers and Scud missiles. Medical miracles lengthen our lives and take national welfare provision to the edge of crisis. Electronic globalization [stymies inflation but] moves jobs elsewhere"-Burke 2000:66.**

### **Was Innovation Top-Down?**

- Writers like James Burke and technologists like Raymond Kurzweil, influenced by the "cult of personality" of the written record and its heros/heroines, imagine that innovation historically was driven by élites, but will now change with the replacement of "information scarcity" with "abundance" due to the digital revolution, but that is debateable from the anthropological viewpoint of "bottom-up" innovation derivable from archaeological evidence, or, indeed, by a closer reading of history, e.g., the zipper.**
- What may not be debateable is the rate of innovation as it feeds upon new data geometrically and the "democratization" of technology (world-impacting computer viruses designed by Phillipine programmers).**

## **Genetic Engineering-A History**

- 1980-First genetically modified mouse, created by inserting a new gene into mouse bone-marrow cells and then putting those cells into a living mouse.**
- 1986-First transgenic sheep born; they carry a human clotting-factor gene**
- 1990-Birth of genie, the first transgenic pig, whose DNA includes a gene for a human anti-clotting protein**
- 1990-First approved gene therapy in a human- a 4 yr. old girl with an inherited immune-system disorder**
- 1990-First transgenic bull; Herman the bull has an extra gene for human lactoferrin**
- 1991-First transgenic dairy cows, which carry a gene for lactoferrin**
- 1997-Unveiling of Dolly the sheep; th first mammal cloned from adult cells**
- 1999-First reported death of a human gene-therapy patient, Jesse Gelsinger, 18**
- 2000-First cloned monkey, Tetra, created by sub-dividing an embryo**
- 2001-Announcement of the first genetically modified nonhuman Old World primate, Andi, the transgenic rhesus monkey who glowed, the result of a gene for bioluminescence taken from a jellyfish**
- 2???-Designer babies**