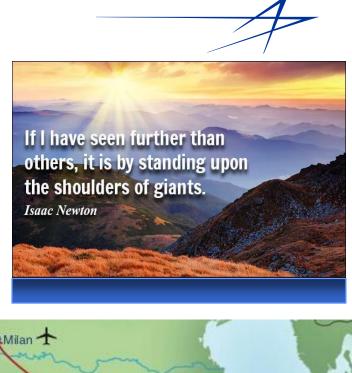
In the Foot Steps of Leonardo da Vinci



Outline

- Excitement and Awe: Audacity of the Course Title
- Humanity: Always walking in the footsteps of Giants
- > Leonardo da Vinci (LdV)
 - Curiosity
 - > Arts, Science
 - Design Engineering
 - Materials Science
- Lockheed Martin
- Faint Footsteps







HISTORY: Distillation of Time Events (1000 years in one page!!?



THE WORLD THIS MILLENNIUM

DECEMBER 31ST 1999

Despite widespread expectain the 1340s brought a huge. tions, the world did not financial crash. end as soos dawned.

The Black Death in 1347-49 China in 1024 issued the first killed millions in Asia and paper money. A Swedish North Africa, and maybe one bank followed suit in 1664. European in three.

In 2009 the first crusade cap-The first European book printtured Jerusalem from the Mused with movable type was lims; in 1187 Saladin took it published in 1457. back. In 1455 Turkish Muslims

took Constantinople. In 1492 In 1492 Cristobal Colon Christians took Granada, the sailed the Atlantic. In 1919 a last Muslim state in Spain. Spanish force seized the Aztec capital in Mexico, Latin Amer-A university was founded at ica in 1810-25 broke free from Bologna towards 1000, at Paris Europe-under, everywhere,

ethnic-European rule. manca in 1218. Heidelberg in 1366. Harvard came in 1636. Martin Luther nailed his 95 theses criticising papal "indulgences" to a church door in From 1206, Mongol armies spread across central Asia, into Wittenberg in 1517. The Refor-Eastern Europe, the Middle mation, splitting western East and, by 1279, all of China. Christendom, was on its way.

But in 1368 a Chinese dynasty was restored, and a defeat in From 1524, Turkic invaders created the Muslim Mughal Russia in 1380 began the westem Mongols' downfall. empire in India. From the 1750s British ones took it over.

From around 1250, European In 1953 the Muscovy Comsailors began to use the (Chipany, of London, issued the nese-invented) magnetic first equity shares. The first compass. In 1433 China's last limited-liability law came in long-sea expedition ended. atta, from New York state.

and Oxford in the 1800s, Sala-

From the mid-16th century until the 19th, Europeans shipped maybe tam Africans, bought from their African captors, across the Atlantic as alayes. Arab slavers took millions more to the Middle East.

> In 1600 the English East India Company was set up. in stor the Dutch one bit steps for world trade, giant ones to European rule in Asia.

Japan cut inself off in 1699 Cimabue was been by 1254. from the outside world, to Dante in 1365, Petraech in 1304. reopen only in 1853-and Leonardo da Vinci (above) in catch up on three centuries of 1452, Machiavelli in 1469, Miwestern technology in one. chelangelo in 1475, and with them Europe's Renaissance. Ruley from 1682 10 1725. Peter

the Great tried to modernise Italian banks were figurish-Russia, From 1924 to 1953. ing by 1300-though default Joseph Stalin tried again. by England's King Edward III

AND ADDRESS OF A DREAM AND A

Newton published his "Principia", setting out the laws of motion, in 1687; Darwin his "Origin of Species" in 1898. Einstein his special theory of relativity in 1905.



From 1733, John Kay's flying shuttle and (1769) Richard Arkwright's spinning machine (in prototype, above) revolutionised textiles, mankind's biggest industry. Driven by James Watt's steam engine (1965), the machines, ships and railways of the industrial revolution gave the world a new economy, society and (briefly) top dog, Britain.

The future United States in 1776 declared itself independent of Britain, and all men created equal: and stuck to slavery until 1865. France in 1789 rose against its royal regime and proclaimed the rights of man; and in 1804 hailed its ruler. Napoleon Bonaparte, as emperor.

Europe in 1848 burst into nearrevolution. Little came of it at the time-except Karl Marx's Communist Manifesto

America's first oil well was drilled in 1899. The first Middle East oil strike came in 1908.

Eleven slave-owning states seceded from the United States in steo-is, but by usis had lost the resultant civil war.

In 1564 the toar abolished serfdom in Russia. In 1987 Marxists seized power these. AVAILABLE OF S MAIL PROPERTY OF CONTRACT COM

In 1864 a unified Italy was proclaimed, in stry a unified Germany. The nation state had triumphed; many new states. and many wars followed.

> In 1896 Alexander Bell showed off his telephone, in 1879 Thomas Edison his electric lighting, in 2903 Orville and Wilbur Wright took to the air; in 1908 Henry Ford launched his Model v car; 1946 brought the first general-purpose computer, 1947 the first transistor. All made in America.

In 1912 a republican regime re-placed China's imperial dynasty. In 1949 Mao Zedong made it a communist one.

1914-45 brought disaster: a huge European war; a communist coup in Russuc global shamp: Nazi takeover in Germany: Japanese attacks on China: a world war and Nani murder of millions of Jews: and the first use of nuclear weapons, against Japan.

> From the late years, Europe's colonies won independence. Many soon succumbed to authoritarian rule of their own.

From 1945 to 1969, a capitalist block led by the United States and a communist one led by the Soviet Union and China fought a cold war. In 1991 the Soviet Union fell apart. China. still communist in manne.



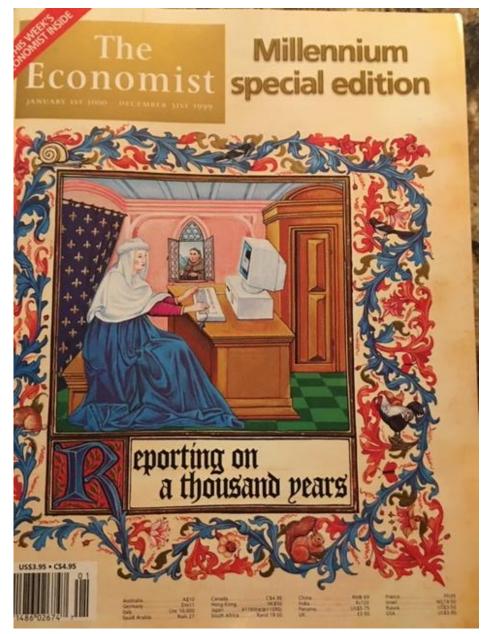
In 1969 an American spacecraft landed the first rate men on the moon.

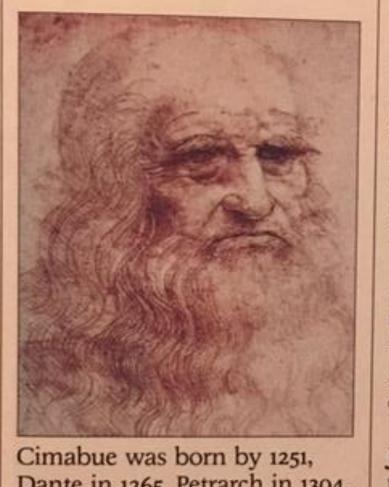
> As 1999 ended, millenarian about to end too.

loonies declared the world

rediscovered market forces.

HISTORY: Distillation of Time Events (Renaissance)





Cimabue was born by 1251, Dante in 1265, Petrarch in 1304, Leonardo da Vinci (above) in 1452, Machiavelli in 1469, Michelangelo in 1475, and with them Europe's **Renaissance**.

LdV Art and Science: Emphasis on Knowing Fundamentals

Course by Professor Rishi Raj:

- Enthuse LDV' Curiosity
 - Creativity (genuine)
 - > Art, Science
- > Understanding of Basics (Science)
- Applied Science and Engineering

Principles for the Development of a Complete Mind: Study the science of art. Study the art of science. Develop your sensesespecially learn how to see. Realize that everything connects to everything else.

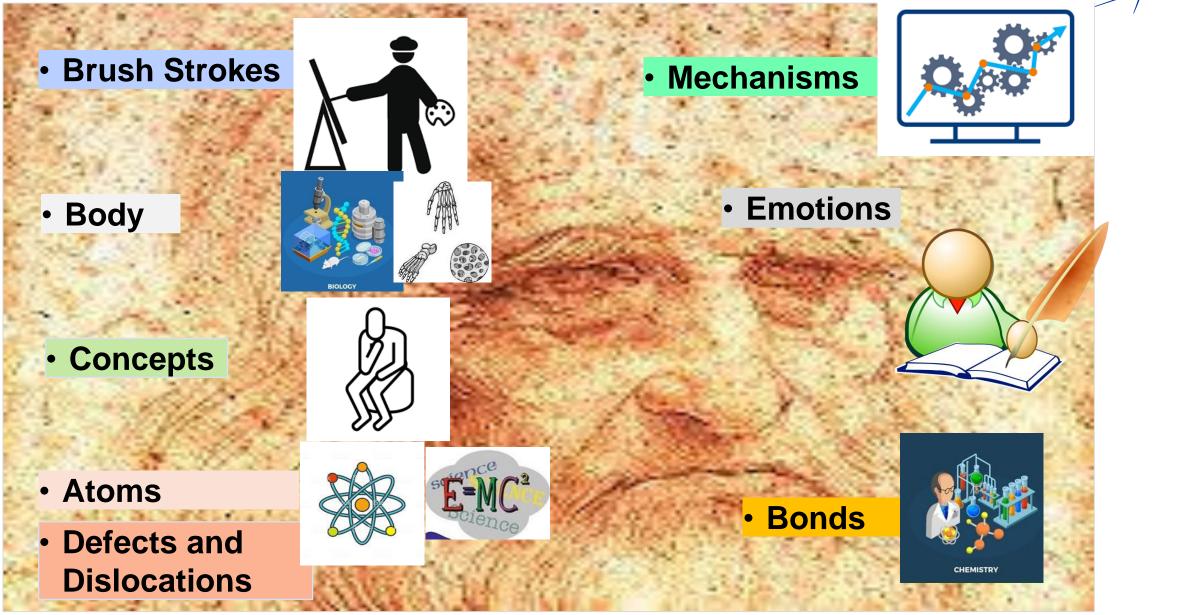
- Leonardo da Vinci

He who loves practice without theory is like the sailor who boards ship without a rudder and compass and never knows where he may cast. " - Leonardo da Vinci

"I have been impressed with the urgency of doing. Knowing is not enough. We must apply. Being willing is not enough. We must do."

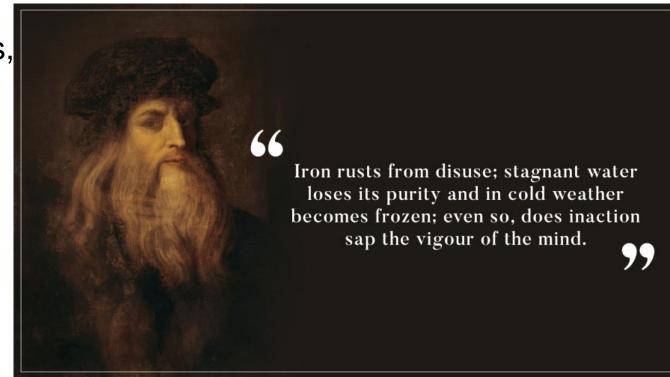
- Leonardo da Vinci

Movements: Art and Science



LDV: Intersection with Materials Science

- Leonardo da Vinci learnt from his Master
 - Paints and Glues
 - Metal casting Statues, Cannons, Cannon Balls etc
- Corrosion
- > Phase Changes



Leonardo Da Vinci: Sprint at Lockheed Martin

- Employee Number: 14520415
- Title: Corporate Polymath
- Recent Job: Apple ③
- > Patron: CEO/ CTO



WATER IS THE DRIVING FORCE OF ALL NATURE.

Leonardo da Vinci

We Do Mars

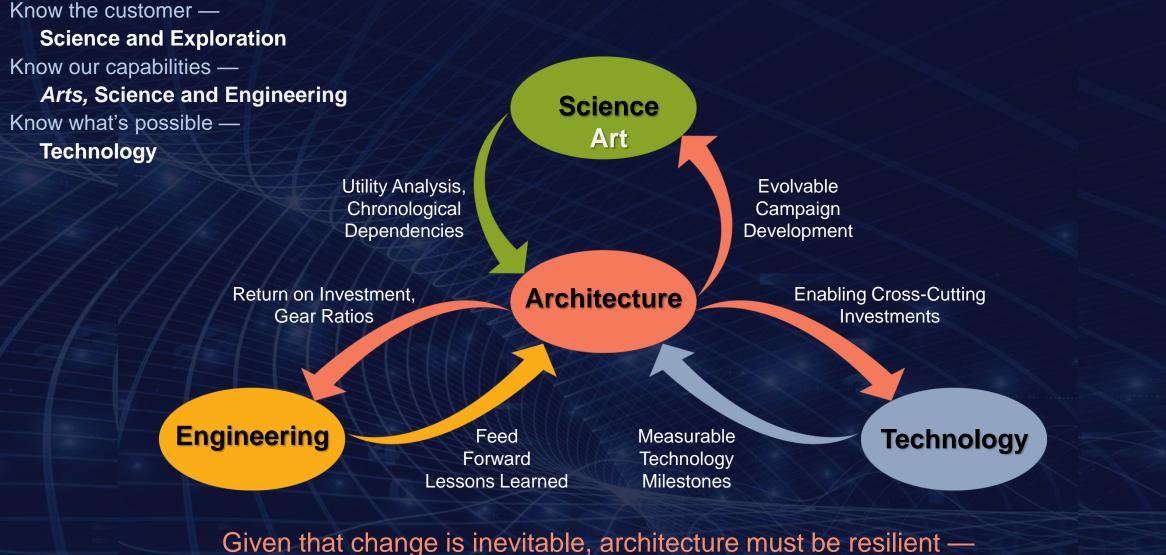




"ONCE YOU HAVE TASTED FLIGHT, YOU WILL FOREVER WALK THE EARTH WITH YOUR EYES TURNED SKYWARD, FOR THERE YOU HAVE BEEN AND THERE YOU WILL ALWAYS LONG TO RETURN."

-Leonardo Da Vinci

LdV' Architecture



able to recover from, or adapt to, change.

Lockheed Martin Business Areas



Aeronautics

- Tactical Fighters
- Tactical /Strategic Airlift
- Advanced Development
- Sustainment Operations



Missiles and Fire Control

- Air and Missile Defense
- Tactical Missiles
- Fire Control
- Combat Maneuver Systems
- Energy

Space

- Surveillance and Navigation
- Global Communications
- Human and Deep Space Exploration
- Strategic and Defensive
 Systems



- Rotary and Mission SystemsMaritime Solutions
- Radar and Surveillance Systems
- Aviation Systems and Rotorcraft Platforms
- Training and Logistics Solutions



Lockheed Martin Space Portfolio

Strategic & Missile Defense





Adv Programs

Strategic Missiles

Missile Defense

Deep Space

Exploration

Optics, RF

Adv. Materials & Photonics & Nano Systems

Space Sciences

& Instruments

Special Programs



Military Space





Protected Narrowband Comms Comms



Weather



Early Warning



Advanced Technology Center

Space Protection



End-to-End **Mission Systems**





Technologies



Communication Systems

Commercial Civil Space



Human Space Exploration



Weather & Remote Sensing

Subsidiaries

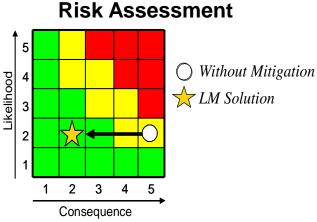
Mission Solutions



ADVANCED MATERIALS AND MANUFACTURING

- Motivation: Advanced Materials and Manufacturing (ATC)
 - Understand Spacecraft System/Subsystem/ Component Needs (Challenges)
 - Develop Innovative Material Design Solutions
 - Enhance TRL (Resources/ success or exit criteria)
 - Explore Technology Insertion Opportunities
- Opportunities: Successes and Challenges
 - System Pull or Technology Push (Pathfinder)
 - Qualification:/ Key Challenges: Proto-Flight to Flight
 - Performance Benefits (Vs. Baseline) and
 - TRL and Risk Assessment (System/Subsystem Level)





Technology Challenge: Nano to Macroscale Property Translation

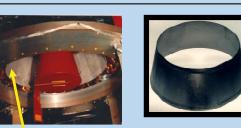




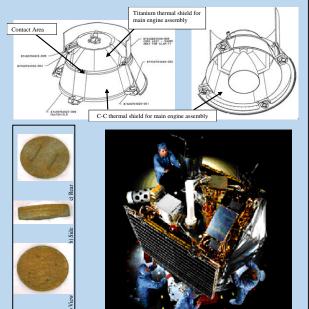
MATERIAL SOLUTIONS FOR SPACECRAFT (RIGOR OF FLIGHT

Propulsion/Thermal

C-C Engine Shield (MGS):



Pt-Coated / C-C Engine Shield



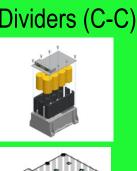
Aeroentry:

C-C Heat Shield (Genesis)



- Osiris Rex:
 - Li Ion Battery Dividers (C-C)







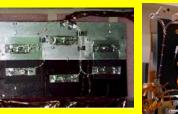
Propulsion: Warm Gas Plenum

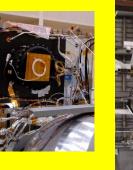
C-C/ C-Foam Core Radiator



Thermal: Doublers:

Misc. Hi-K Composites (MGS to Osiris-Rex)









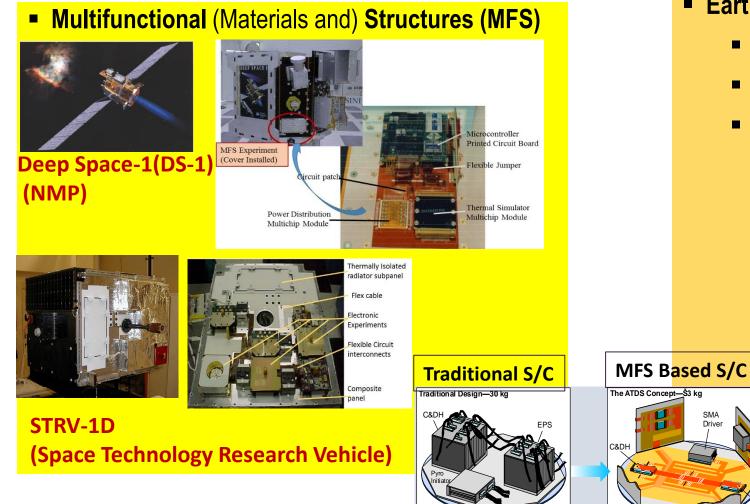
NEW TECHNOLOGY PATH FINDERS



 Carbon Nanotube (ESD/EMI) Additive Manufacturing (Ti-6AI-4V) ouse Brackets Tensile Bar



DoD/ NASA FLIGHT OPPORTUNITIES



6U-VME Cards

Composite Chassis

Conventional Cables/Connectors

- Earth Observation-1 (EO- 1 New Millennium Program (NMP))
 - Thin Film Solar Array
 - Shape Memory Hinge (Deployment)
 - C-C Structural Radiator

ATDS

Integrated C&DH and EPS

Multifunctional Structure (MFS)

High Density Interconnect (HDI) MCMs

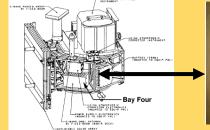
Highly Integrated Processing & Packaging (HIPP)



Space Shuttle Experiment

SMA Hinge

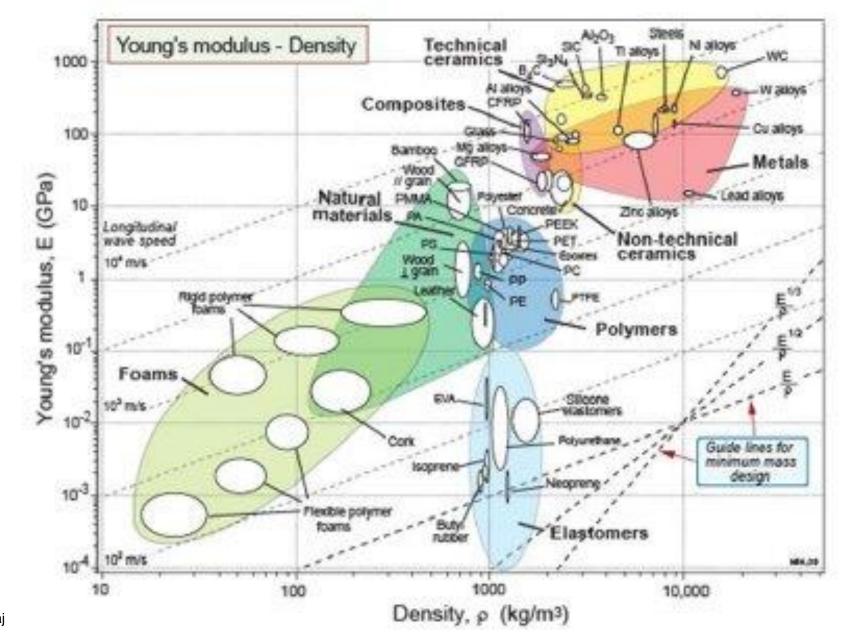






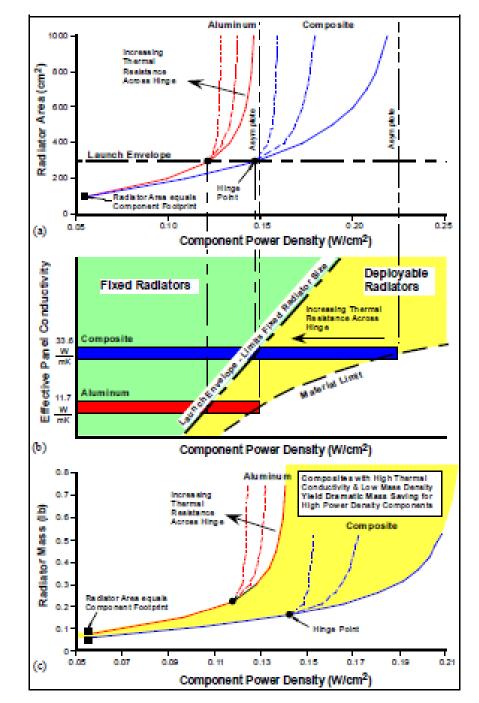
LOCKHEED MARTIN

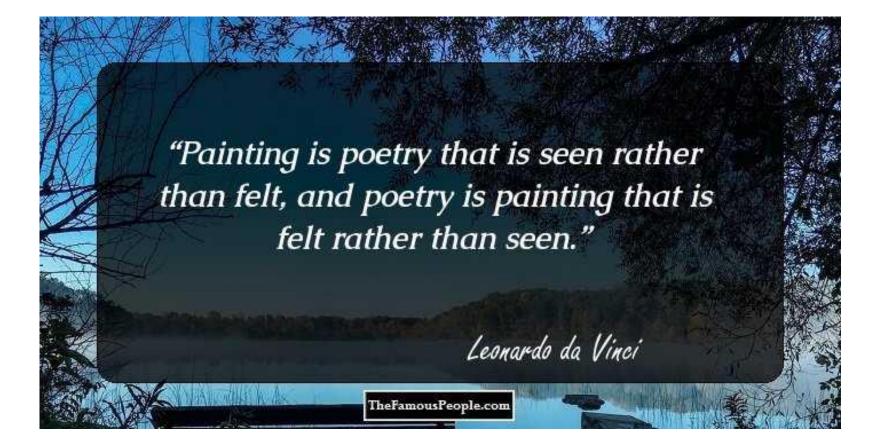
Ashby Diagrams: Applied Science: Art?

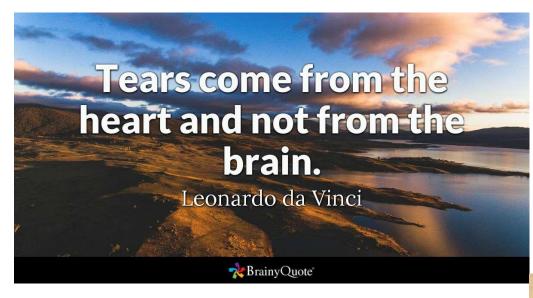


2019 Leonardo Da Vinci_Rishi Raj

Radiator Design Domains









Sheltered in these Eyes,

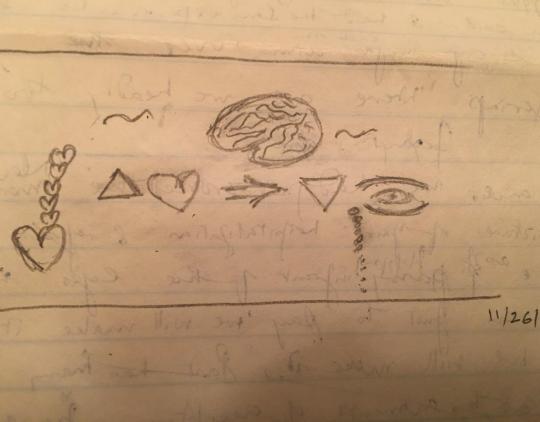
Watch these Tears

Cradled in this Crib, spoken a lot

Suffered enough,

Taking last journey, getting lost

Some tears: never reached the corner of eyes Some smiles: could not reach the corner of lips



Phase Diagrams of Personalities and Emotions

Juis James Eutertic	Jandie Judy James
focial Compromise	found solid Relationships
	Kelationships

Chinese Love Poem

Nothing ever shall keep us apart

Life a Question Mark

.

Times of fun became an old story And all moments became crowned as youth Youth was a fast flowing stream and he was all absorbed deep in himself. Every step was heavy with responsibility There was noise all-around, but he was sile Apparent pace of time was such

that Youth wrinkled into Old Age

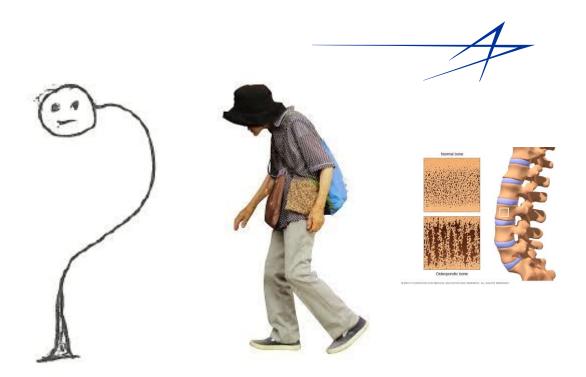
He kept on looking far behind

To understand the meaning of this journey of life Burden of questions piled up in plenty

And he kept on bending down as a Question Mark The ropeway of life had its end at this end

But man in nervousness just cut short the rope

Suraj Rawal (Own Hindi Poem's translation)



While I thought that I was learning how to live, I have been learning how to die. Leonardo da Vinci

Life : A Question Mark

The ropeway of Life had a distant end An innocent child caught it started to walk He loved to listen to the tales of fairies The flock of butterflies, used to make him run. When he insisted on hearing the hillaby, then mom would cradle him to sleep on her lap

Emotions wove a nest of memories And naughtiness squeezed into adol-Tides of Excitement were rising Discourse became a bothersom Color and beauty bore soft cor And longing for someone starte

Times of fun became an old story And all moments became crowned as Youth was a fast flowing strear and he was all absorbed deep i Every step was heavy with re-There was noise all-around, but

Apparent pace of time was such that Youth wrinkled into Old Age He kept on looking far behind To understand the meaning of t Burden of questions piled up in And he kept on bending down

The ropeway of life had its end at the But man in nervousness just cut shor lap

जीवन : एक प्रश्नचिन्ह

जीवन की डोर की दूरी पर छोर्ड थी भोला बचपन पकर्द के चलने लगा

परियो की डोली थी भ्हाती उसे थी तित्लीओं की टोली भगाती उसे होती थी लोरी की गुनगुन सुनने की धुन तब थी गोदी में ममता सुलाती उसे

भावुकता ने मोतिओं की माला पिरोई चंचलता सिम्मट कर ;लरक्पन में खोर्यी

हर उमंग नयी तरंग को परखने लगी हिदायतों की आहट अखरने लगी रूप रंग का नशा घटता बढ़ता रहा और चाहत की कालिया चटखने लगी

गुज़रा समय अब कहानी बना सजधज के हर पल जवानी बना

थी उभरती जवानी नया जोश था खुद ही की दुनिया में मदहोश था हर कदम पर नया बोझ बढ़ता गया बहुत शोरोगुल था, वोह खामोश था

सिलसिला अब समय का कुछ ऐसा चला झुलस कर के यौवन बुढ़ापा बना

बहुत देर तक पीछे ताकता रहा इस सफर के वोह मायने समझता रहा सवालो का बोझ बढ़ता गया और आदमी प्रश्नचिन्ह (?) सा बनता गया

जीवन की डोर की छोर इसी और थी घबरा के इंसान ने डोर यहीं तोर दी!

Suraj Rawal (Own Hindi Poem's translation)

इंसान : रोज़ सवालों को दफनाये जाता है नयी जिंदगी फिर उसी तरह से चलाय जाता है 2019 Leonard

2

Ma, Let me Go

माँ मुझे जाने दो

अपनी एकलौती बाहं में समेट कर हांफती कांपती चीखती चिल्लाती मेरी माँ बेतहाशा भागती फिरती हैं छत ढूँढने के लियें, ताकि ढक सके मेरा बदन

> छत जो बहुत ऊंची है धुन्दले तारों से लदी है कदमों के तले राख है या खून से सना कण कण

रह रह के कह कह के चूमती है मेरी मां कफन में लपेट के दिया हैं तुझे बचपन

> जंग एक तरीका है ज़मीं बांटने के लिए ! बोम्ब एक औजार है फसल कांटने के लिए ! नाश एक नशा हैं सभ्यता मापने के लिए !

दूर तलक कोई नज़र नहीं आता अब बोम्ब क्यूँ गिरते हैं ज़हरीली गर्द की तह पर तह जमती है तहज़ीबी सबक का नया सफा लिखती हैं

माँ अब में बडा हो गया हूँ मुझे जंग जाना हैं बोम्ब जुटाने हैं ताकि तहस नहस कर सकू सिआसती बहस में सभ्य कहला सकूँ माँ मुझे रोको मत माँ मुझे जाने दो!

2019 Leonardo Da Vinci_Rishi Raj

Cradling me in her only arm Screaming trembling huffing and puffing Wayward, hither and yon runs my Ma to find some shelter to find a safe cover for me

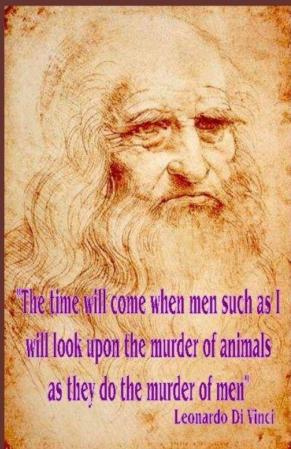
That roof is very high shingled with clouded stars she walks on the ashen dust or on blood-soaked sand clutching me and kissing me mumbles my Ma "Alas wrapped in shroud gave you this life"

War: a proven method to divide the Nations
Bomb: a modern instrument to instantly mow the crop
Destruction: an Intoxication a measure of the degree of civility

Can't see a single soul, but Why do these bombs still keep on shelling Poisonous dust settles layer by layer Scripting page by page dark days of modern civilization

Ma, I am a man now I have to go to the warfront Gather some bombs and guns So that I can also destroy And be called civilized in the political debates Ma, Don't Stop Me, Let me go [See, World has heard enough of our bombs Let none of our children, suffer our plight Peacefully, peacefully 'will settle the fightMa, bless me



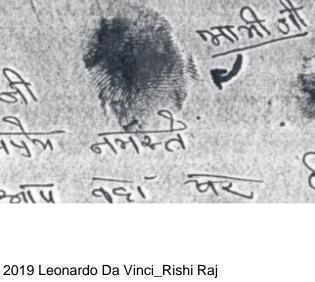


Who am I

- Language and Grammer of Life
- Composite
- Reading thumbprints
- Recipe of relationship

to your inlaws

with best wishes



Jarby are and Idea Oo delixion I for weet to say and hat taken a fremetric At that of mas innorence fathers Indianal in swam her still left en. munny & where Tom film up all the space Jast pere hip to Ironizally elements of time, not the sense of it. Your Brothing adventure or a new ThRawhl 1 T.S Honesty 2 TS Trust 1 to warmth i dash Silliness 1/275 Sensitivity da Baken in over of understanding Le kept v. alive during

Stories to tell





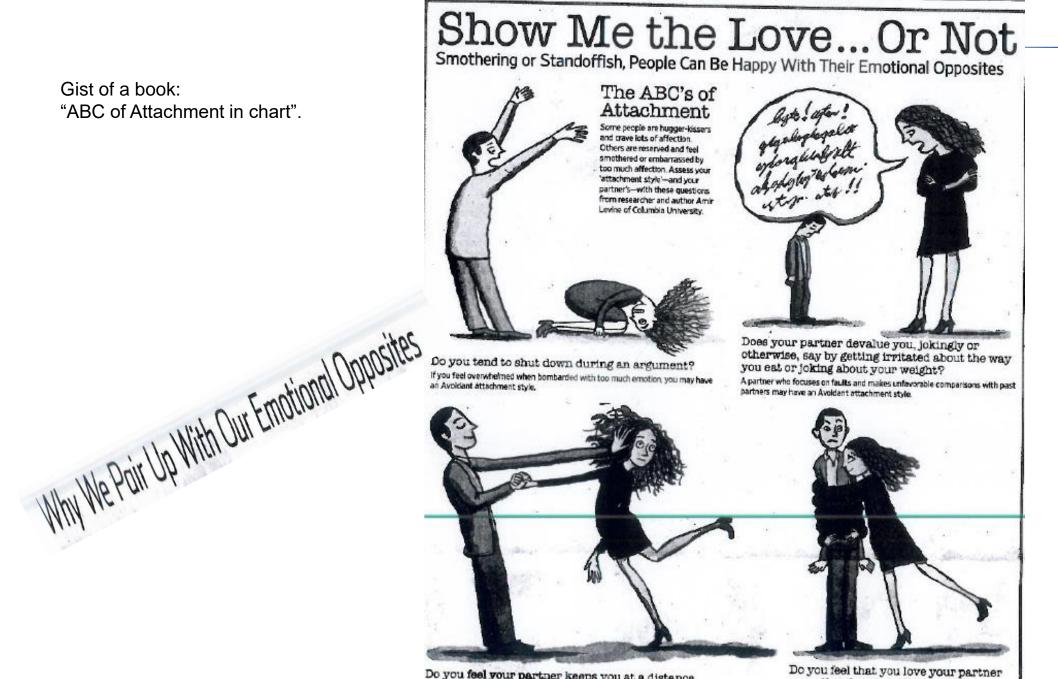




Rocks" Stories to tell - Sea of Galilie

Shells: Stories to tell

Till Yesterday this Autumn leaf was green Gist of a book: "ABC of Attachment in chart".



Do you feel your partner keeps you at a distance emotionally, physically or both? Being irritated or unnerved by too much closeness is a halimark of the Avoidant attachment style more than he or she loves you? Being constantly on the lookout for signs of rejection is a halmark of the Anxious attachment style

Materials Technology has Enabled Technology Revolutions

• Breaking the Evolutionary Paradigm: Multidisciplinary Effort (LDV's Spirit!)





" QUOTEONARY

LOCKHEED MARTIN

Thank You Very Much





Real Talent

real talent = ability(hard work) + consistency

d(real talent)/dt = ability × d(hard work)/dt,

Happiness (Satisfaction!) Happiness = (Reality/Expectations)

Getting Together

