

MY TRYST WITH SCIENCE AND TECHNOLOGY

IN INDIA

by

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(Lecture at Vande Mataram Forum
of IIT Madras (Student body recognises
by IIT Madras) 6 to 8pm)

Thanks Organiser!!

" உங்களுக்கு லாஜிக் தெரியுமோ - என்னை
லாஜிக் தரிசை உணர்வதென்று தெரியுமோ "

Hope many of you would have heard it!

Rough Translation.

We will say Vande Mataram -
will say " We bow to ~~you~~ OUR
Mother of this Great Land "

The Man who sang it ~~more than~~
very
at the beginning of the 20th Century

He was the Great Inspirer in my life.

Can you say who

"Subramania Bharati"

"கந்த நகரீயலகர் லேசுமுறைதரத்
கந்தீயியி கேட்பதற்குரைந் ~~து~~ அருளிசெய்யோம்"

"ஆயுதம் செய்யோம் நல்ல வாகுதம் செய்யோம்
ஆணவகன் தையப்போம் கல்யாண் சந்திரன்
தையப்போம்"

அந்த மண்டலத்தினால் கண்ட தெய்வோம்
அந்த அருப்பொருக்கும் அந்தீயம் கற்போம்"

~~What~~ What is talked by ~~the~~
scholars of Kasi, we will make
Instruments to be heard in Kanchi...."

We will make armaments; (also)
good papers; will build factories
and Educational Institutions"

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" We will ~~at~~ find out the science of the moon
(Also) science of cleaning our streets..."

See what a sweep! What a vision
for his country "Bharata Desam"

— the ~~title~~ title of the song / poem.

These thoughts were ~~imbedded~~
imbedded ~~into~~ into me at my
age of Ten.

Role of Science, as he
saw was much more: not just
publishing papers ~~for~~; while
he admired basic knowledge too!!

But it did ~~not~~
~~This thoughts were imbed~~
Still my desire was to
become a poet!! Took Special Tamil

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in my 7th standard, not Sanskrit
which would have ^{given} lots of marks
in SSLC! That was at the High School
St Xavier's - at Palayamkottai. I enjoyed all subjects!
But what was bugging
me was ~~the~~ also the fact that
Tamil teachers were the poorest
among my teachers, ~~as~~ as they would
not get any tuitions!!

~~E. I came to~~

Family moves to Bombay
in 1957. Joined ~~SSLC~~ ^{final} SSC

11th class in S.I.E.S. school -
English medium... I was 13 years

~~Bharathi~~ ^{bound} Bharathi was
with me with the book I had.

Due to my uncle's (N.S. Iyais)
rich collection of English books

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Enter Swami Vivekananda,
Jawaharlal Nehru and many
others.....

Vivekananda emphasizes
Science. Nehru too.....

Oct 1957: Sputnik
launched... As I was about
3 years younger to the whole class
& I was teased fondly as
"~~Who~~" "Soviet Union sent Sputnik
into space; who sent this Sputnik
to this class?"

~~Some~~ I was proud of the
Soviet achievement. But it
did not ~~sent~~ make me feel
to get into space work... Nobody
in India, even our Professors later

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Bunkup
in University ~~later~~ knew anything
about Space — no reference in
Physics classes even at M.Sc.
level — some thing on Atomic
Energy was ~~then~~ known as
fission — fusion

~~So what~~
But I had gone into
Science stream ^{in college} ~~and~~ without
a clear idea as to what
I will do ... Some idea of
applications; to do some ^{useful} instruments ...
may be. So went into

M.Sc. Physics with $\&$ Electronics.
I ditched Maths which I loved,
at B.Sc. (Hons) level itself by
making it subsidiary. But I love all Science, maths etc.
Had seen $\&$ gold medallists

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maths teachers struggling
to get a tutor job in the
colleges!

So there was an utilitarian
break in my thinking too! ...

~~So who~~

So let me ask,
What is "TRYST" — some thing
a prearranged meeting;
a rendezvous That is dictionary.

Was it for me?

At each stage in my life
whether at a unit of week, month or
years, I did not see any
prearranged meeting of opportunity
or event in my life.

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When I look back all of them at my age well past 70, & it appears that God had ordained something for me. Each twist and turn in my life, some great ~~job~~ joys and some great disappointments — all of them seem to have been predetermined, to chalk out a course of life for me....

Now I don't ~~regret~~ regret any of them... But when I was moving on ^{with} life, I never seem to have been fatalistic. It appeared to me that I took conscious decisions ^{with} always pre-planned ones.

So it was, when I went to interview — my first one for an

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earning cum Ph.D. course -
Tests, interviews etc - some 200 odd persons

So the job

Successful... moved to
Ahmedabad... I needed the princely
sum of Rs. 300/- to p.m. to take
my Periappa / ^(father's brother) & Periamma with me...

~~Has~~ Learnt a lot there.
Physics Space Physics; ^{practical electronics} engineering;
also lots of Marxism, etc. - some
economics...

The great Vikram Sarabhai
was ~~a~~ my next door neighbour
in PRL... ~~Never~~ A very magnetic
personality... Never felt a difference
of conversing with him. There was
great things taken away unnecessary

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fears from mind.

शुनो भयं

(Shun Fear) was

Bharati's dictum.

Later in my life ~~for~~
~~at~~ when asked what I learnt
for myself from Vikram Sarabhai, I said

- o Intellectual Irreverence
- o Organisational Discipline
- o Innate Humanism.

None even now as guiding principles
of my life.

Many more greats of
Indian Space Program — I was
moving with them, as person of in
~~early to~~ early twenties.

* Notable friendship with Kalam
in 1965. And UR Rao

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~~C. R. Rao~~

truly
Other ^{big} ~~things~~ ^{achievements} you would not
have heard of!

Under very interesting
circumstances, after about
3-4 months' ^{regular} weekly meetings
personally with Vikram Sarabhai
I quit Ph.D program ^{after two years in PRL}. But
he put me as Engineer in
INCOSPAR (pre-cursor to ISRO)
He did not let me go away...

It was a great career
decision — looking back great
~~great~~ hand of Destiny... Closeness
to Sarabhai

Rocket transparency...
Design to ~~D~~ Successful Delivery
to Users...

led to going to MIT/Lincoln
Lab — INSAT study — NASA.

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As my ^{wife} ~~came~~ ^{joined me} ~~with~~
later in ^{USA} NASA with an small child
& son, ~~later~~ tells: ~~at~~ Sometimes.
"The life in USA at a young age
makes one to be independent,
self-reliant".

Learned a lot of about
social life and lots of
space - satellite technology
Self - confidence about my
knowledge & skills ... No
special efforts except working
hard and taking on newer
tasks which NASA managers gave.
Sarabhai's death when I was in USA...
A great pain - ~~Let a~~ NASA/US experience even the
great companies were - I learnt a lot from US engineers,
led to being taken by Mars

Prof S. Dhawan for ISRO Headquarters.

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I wanted to design,
develop satellites - Project Manager.

~~Dhanu~~ I resisted Dhanwan's
efforts to take me to ISRO HQ
that was late 1973 when he returned India

"Sir, I heard within ISRO
that ISRO HQ is a mortuary"

Great reply & by him in
three words, after a pause of
~~a few minutes~~ a couple of
minutes

"Well, it depends." He
talked then on many plans.
I ~~know~~ understood

Dhanwan had decided
about my future trajectory...

So I was in ISRO HQ

to become the youngest "Scientist"

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Secretary ISRO" ^{some of} ~~the merger~~

~~part also sometimes~~
Deeply involved in Aryabhata first etc etc

It was like a COO
but I was also involved in
strategic planning.

One to that ~~Then~~ Dr. Brahm Prakash

T. N. Sesham . . .

etc etc .

A rapid growth in an
entirely new direction ~~shaped~~
broadly directed by Dhawan
but Prodden (~~event running~~)
~~was~~ (in fact running
a sprint and ~~the~~ marathon) by me.

Most exciting, but also
most difficult period . . . Most of

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top management of ISRO -
great achievers - were at
least 15-20 years older
to me. Kalam ~~13~~^{12 1/2} years older!
But I had "lots of power"...
I never felt it... Nor did
it make me arrogant...

A great certificate
to that effect was given
by Kalam much later
in his life, in his book
"Wings of Fire" around 1998
while referring to his SLV-3 times (1974-1980's)

"I had the fortune of
having Y. S. Rajan, from
ISRO headquarters as my
friend in those times. Rajan
was (and is) a universal friend.

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His friendship embraced with equal warmth turners, fitters, electricians and drivers as well as scientists, engineers, contractors and bureaucrats. Today when the press calls me a "welder of people",

I attribute this to Rajan. His close interaction with different work centres created such a harmony in SLV affairs that the fine threads of individual efforts were woven into a mighty ~~for~~ fabric of great strength"

From Wings of Fire

1998

How much I deserve such

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a praise after ~~to~~ about
20 years ^{about} ~~of his 25 to 23 years~~
when he was a great Missil-
Man and darling of Indian people
(even before he became President
of India) and when I had left
ISRO, I don't know..

But I have friends from
ISRO even now in all the
categories he mentions...

Vikram Sarabhai's warmth
she gave when I was in PRL ^{20 years} for
about 7 years (1964 - 1971 till his
death), freedom he gave to
later work in ISRO with many
colleagues ~~at in my time~~ and

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working ~~in~~ ^{with} best space institutions (all in my twenties)
industrial ~~in~~ in ~~AAS~~ USA. Later the

mighty force of S. Dhawan & ~~(Gross)~~ ^(BUT a)
~~Rosa~~ & the Solid/Dharmaputra
Prakash, TN Seshan etc
Brahma ~~Prakash~~

→ from my early 30's...

All of them shaped me.

~~with where~~ Bharati, Vivekananda,
Buddha,
& many others including Marx
~~wants also to be the~~ might also
have been the inner lights...

Love given, gives you
back tons of Love.

But it was not a
wishy-washy goodie boy... I ~~was~~

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Supposed to have been a
tough person... forthright...

To best of my knowledge

I always worked in the ~~the~~ best
interest of ISRO (and therefore
India)...

The mighty Dharwan
would have kept a great watch
- may be... may not be...

His method of keeping persons
good and productive was to
place TRUST!

Between us, there was
a huge personal correspondence
- confidential, personal, to be
opened by addressee type... OTHER

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than many thousands of internal memos and reports in ISRO files ...

Even ~~some~~ ^{many} of my confidential notes to Dhawan would be in ISRO files ... In some I severely critiqued his delays in decision making — ~~some~~ in

some, I remind of being ^{some very angry, some philosophical...} actions; ^{some} All these private

communications which may run to some ~~1000~~ ^{or more} pages during my ~~time~~ 10 years with him as Chairman ISRO (me holding several positions in ISRO, in addition

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Scientific Legacy ISRO), ~~may~~
~~be about 2000 pages~~

There was some
24 years of difference between
us. He would be like my father-in-law.

Can you imagine that
he had kept them carefully
in a special big hand bag
(a Russian leather like bag)

and gave it to me a day before
he laid down office in ISRO.

"Rajan: all your ^{personal} notes
to me are here ~~to~~ want to

keep it or put in ISRO files"

~~Sir~~ I was surprised

"Sir all typed ones will be

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in ISRO files ... Only a few
~~had~~ handwritten personal are
not there ... "

" Whatever it is, you
keep it with you and do
whatever you want ~~it~~ with them! "

I had been carefully
keeping ~~it~~ them with me.
Occasionally seeing some of them.
Over the past ~~to~~ 7-8 years

I started looking at them ..

What a precious archive ..

I have used them to write

some thing ~~h~~ ^{about} shaping of
the ^{ISRO} organisation ~~from 19~~ in 1970's
and 1980's .. .

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What a great man he was!
When people would like to present
their nifty actions as great
achievements, a person is giving
~~his~~ the notes written by his
subordinate staff, many of
them irreverent, criticizing
him...

He had a great historic
sense too!

We had some ^{common} features
in our outlook on life ~~too~~ ^{as well!}...

Very few persons in the
world would have ~~his~~ ^{two}
opportunities to be shaped by
a great scientist/engineer and

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Brilliant technomanager, ^{visionary} and
a great humanist like Satish Dhawan
from their age of 30. ~~†~~ His
guidance to me continued much
later.

Dr. BP, ^[was also a great mentor] ~~†~~ Simultaneously

It was a rare period in ISRO,
Indian S&T. Two great persons

Number 1 & 2 working together!!

I was a gainer too.

Dr. Kalam mentions about
both of them in his books
and speeches.

Then TN Seshan &
one Y.S. Das Additional Secretaries
of DOS from 1974-88 in the

(D's)

I in the ~~seventies~~ 1970's
& 1980's.

That Administrative
experience (~~direct~~) (desires
by Dhawan as ^{me} Scientific Secy ISRO)
was needed for the well
being of ISRO

deep
Then international experience
of so many countries
Leadership in UN delegation
— all as desired by Dhawan

for me.
In some top secret strategic studies from
1975 onwards
Looking back ~~at~~ I
wonder what ^{Pr. Dhawan} he saw in me!..
What he wanted me to become in life?

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Then of course Kalam.
In ISRO he was in a relatively
lower level of top ~~mag~~ manager
as Project Director SLV-3 -

~~He grew~~

I can mention many
other names... who had
contributed to India, in ^a no small
measure; Y. J. Rao, U. R. Rao,
Wg-Cdr K. R. Rao, Dr. Gowariker,
A. E. Muthunayagam, M. R. Kurup,
— ^{some} my seniors, and hundreds
of others in equal level or
junior to me....

What a learning?!

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altinson

It was not that everything
in ISRO life was \$ milk and
honey! ~~Not~~ a bonhomie!
Nor a good nice orchestra!

Indeed no!

It was like anything else ~~where~~
where a lot of ~~set~~ dynamic
bright professionals see their
livelihood, pride, prestige etc. There
were ~~intense~~ jealousies, intense
competition - some fair and some through
unfair means -, conflicts - professional
and personal. Some had misused
their administrative and managerial
powers to settle personal ~~score~~ or

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professional scores . . .

ISRO
Still work went on . . .

"Work welds!" is some thing

Prof Dhawan will tell me while

~~for~~ discussing such conflicts
He had set up a system, which carries
on even now!

~~To be the
Because of my position in
ISRO, the great examples of~~

Yes ISRO ~~is~~ is great
in team work: but it had its
own internal tribal formations
- tribal conflicts: inter-tribal
& intra-tribal conflicts! Also
new alliances of TRIBES.

Dr. BP & Dhawan were

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that tougher, greater work
for using ~~SAT~~ T for ~~the~~ India
and people.

My writings to S. Dhawan,
I referred to, mention these ~~too~~
realities too and the need for
me to leave ISRO ^{Dooner} ~~Dooner~~
or later, as it had stabilised
with systems - reasonably robust...

Some ^{are} reflected in my poems written
at a later ~~the~~ stage in life...

Such situations also led
to a vegetative period for Kalam
after his successful flight of SLV-3

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, first Indian launch... He was 49 then? (1980-1982)

He got ^{out} LG it ~~from~~ when he joined DRDL as its Director for Missile Programme in 1982.

I did contribute a bit to his

departure - Some major tasks where I played a key role in

ISRO/DOS was to develop Decade Profile 1980-90 and 1990-2000. Another was the establishment of National Natural Resource Management System (NNRMS) which integrates space capabilities with various sector agencies (Zoology, Remote Sensing, etc.)

cast for ward... After Dhanwan retires at his age of 64 years 1984. U R Rao ^{took} takes over.

Some difficult conflicts too - I had the same position, moderating some of it, not fully successful.

~~was~~ A senior most Director ^{had to} leave of VSSC, Dr. Varant Govarikar

parts of States of India. A surveillance centre etc etc

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Later he ~~to~~ ~~came~~ ^{came} to
Indiam ^{SAT} ~~Secy~~ as Secy DST.
TN Seshan ^{went to} ~~at~~ Delhi ^{lastly to DST}. He wants
me too to work with him...

Finally I ~~to~~ ^{went to} DST
in July 1988 to establish TIFAC
Technology Information, Forecasting
and Assessment Council. After
a series of twists and turns!
I had two roles one as Adviser DST
& other as the Executive Director TIFAC
(to use modern parlance CEO TIFAC)

Secy DST was Vasant Gowariker -
who brought me in. Chairman of Governing
Council of TIFAC was Dr. V. Krishnamurthy
doyen of PSU Leaders/Managers. BHEL,

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Later SAIL & Maruti — when he was ^{one of the most} ~~most~~ powerful person in Delhi.

I learnt a lot in orientation S&T towards industry — small, medium & big and for different sectors of economy — a great learning.

It was really taking S&T and deriving knowledge to people of India on a large scale. There were top industrialists from Pvt. & Public sector too.

Kalam was ~~not~~ a member of AC but helped by leading ^{Study on} Composite Materials to lead to a Mission.

TIRPAC worked on Sugar, Fly Ash, Composites, Steel, Leather in a major way and hundreds of other focussed sectors...

ANR just stayed with reports

TIFAC (34)

but ^{it} took a proactive role in
making Industries to ~~produce~~ ^{do} products

& services with Home Grown Technologies..

~~It~~ (1990's). It was a form of
Venture Capital funding ^{A pioneering role}. They

have to return the money after

success... ~~There~~ ^{Sept} There were many success
stories.

~~One~~ In ^{Sept} 1993, Kalan
who had already come to Delhi
as Secy DDRD & SA ~~to~~ Rm in 1992
he became Chairman TIFAC AC.

One of the product was a major
national exercise Technology Vision for

India 2020 in 17 different

sectors. Resulting in a famous
book India 2020 in 1998.

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TIFAC ~~work~~ and DST
work shows me all the infirmities
afflicting S&T systems in India and
also the general Govt systems for absorbing innovation -
~~They~~ were not like ISRO - no
S&T ^{institutions} focussed end-product. No projectisation,
no team work... Mostly individual
efforts & competition, by all means.
Thus the huge funds given by DST,
DBT etc were lost in ~~small~~
individual efforts of good bright
men and women, who had to
waste lots of efforts in being on
the right ~~at~~ side of the paras-
chat-be. There were bitter fights between
"top leaders" of S&T ~~institutions~~ (having extra-constitutional
roles!) fighting for para. TIFAC & ~~an~~
particularly Gowariker & me, felt those pressures...

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Practical success of TIFAC is ^{There} for all to see. The fact that Academic Institutions ~~can~~ ^{can} orient projects to Industry and take technology leadership ~~was~~ to commercialize products was proven by TIFAC - CORE's some 30-odd all over India....

I consider TIFAC work really
as my $\frac{1}{2}$ Cryst with SBT - all
the inner working which I referred
to before coupled with the experimental
ground of ISRO for national reach

~~to~~ made that possible....

Kalam coming to Delhi, growing
in power, being Chairman TIFAC
helped a great deal being

a "Karach" against several bombardments
from outside. ^{means ~~within~~ from within INDIA!} ~~from some~~ I
have referred to it before.

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After finishing major tasks of I TIFAC within 8 years of my ~~last~~ starting as founder CEO, I decided to quit the scene. ... My substantive job was Govt job: Adviser DST. I took voluntary retirement from Govt and joined CII - still the continuing task of taking S&T to industries - I was a part of them. Also I had excellent relations with many ~~competing~~ competing Industry Associations (FICCI, ASSOCHAM) all of whom participated in TIFAC Vision 2020 exercise. ...

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I was requested to stay on with TIFAC with my role. ~~with~~ ~~taking salary!~~ I did without salary, as I did from Day 1. TIFAC ~~was~~ was my love. It was till Nov 2002
to Past Forward -

- PSA office for 2 years (Kalam was PSA)
Many reports... could not influence GOI policies much as
- Then Punjab Tech. Univ (was required)
2002 - 2004 &

Scientific Adviser to Punjab CM
at MOS rank

Great experience in
human resource creation for

real ~~in~~ OUTREACH of SIT...
Came to Delhi - back to CII. Now
~~that then left Delhi~~

role mostly from School to Higher Education
Skills etc. Many of them still continuing.

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Moved from Delhi to our only home in Bangalore in 2009
Coincidental that Dr. K. Radhakrishnan

~~the~~ ~~to~~ had just become
Chairman ISRO. He was kind enough

to ~~give~~ make me Dr. Vikram
Sarabhai Distinguished Professor

& Chief Mentor of ISRO Strategy
Group - ~~per~~ 225 young persons

35 to 52 years of age - To

A major report by the Group

"A Beginning of a New Future"

Also was Chairman BOG of

NIT Manipal 2010 - 2015.

Most satisfying but challenging job..

From near zero to a stable

Institution...

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Many books ~~§~~ ... Many talks
all over India, ~~§~~ - by me.

Science in its fullest form
with its breadth and depth has
been and is a part of my ~~life~~
thinking and living...

So also the great civilisational
knowledge of our country with its
religions, literature, art and
~~also~~ above all simple living of
Indian people... The Bulky Base of India -

God's Grace .. I am still
active, doing my ~~best~~ service / Karma
~~is~~ as per my understanding of Bhagavad
Gita and many great Tamil Bhakti,
religions literature...

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I am leaving out many other things like the books, I continue to read all my life, not just science & technology, but many of them too...

o Great ^{LEADERS} persons like

o Murray Gell Mann:

o ~~Mind~~ Max Del Brück:

o Sustintha Anantilake

* || Not told about the loving family which was crucial to take all pressure of my professional life. I stop there.

You may want ask questions

One last important item:

my trust with S&T in India is still ~~not~~ incomplete. Many unfinished TASKS dreamt of by me and Vikram Sarabhai...
SCALING UP SUCCESSES IS VERY DIFFICULT IN INDIA

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~~At~~ How much Indian R&D
be it in Labs, IIT's, ~~at~~ Industries
have reached large scale COMMERCIALIZATION?

What about ~~at~~ India's equivalent
of Space X, or Nuclear ~~Corporation~~
Energy Plants or So many ~~of~~ Commercial
Satellite Corp or India make Aircraft, Drones?
Google, Microsoft ^{like}
Or a Hawaii ^{5G} company
or a few Major Software
Products sold by India globally
or ~~is~~ Manufacturing giants
or Modernised Agriculture with
low water ~~crop~~ consumption
almost Monsoon-proof
or Education for Bulky base
~~for~~ with modern Skills.

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S & T institutions, Depts, S & T
leaders, Academicians are partly
to blame; partly Indian Businesspersons.
... But that is not the full
Story...

There are OPPRESSIVE RULES
of GOVT OF INDIA and that of STATE
GOVTS and LOCAL BODIES ...
One Example:
= If a product is done with Indian
R&D, then ~~Govts~~ they ~~CANNOT~~ ^{ARE BARRED FROM}
~~RESPONDING~~ TO GOVT TENDER unless
they have TWO year EXPORT EXPERIENCE!
Lo & behold, this condition is waived
if they have FOREIGN COLLABORATION
NOT A BRITISH MADE RULE -
this RULE is MADE IN INDIA.

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We had been fighting about it
during our days in TIFAC / DST

Later in PSA's office.

Such ^{rules} ~~of~~ are there for 70 years.

Like this there are ^{blocking} many RULES

not policies (we use bombastic English
in policies & for self-reliant India!)

which need to be abolished, if

the ~~of~~ TRYST OF ~~MANY~~ INDIANS

with S&T has to be completed

for the benefit of all - - -

That is the major job before you all...

I stop here

Now ~~to~~ Questions -