Prof Narasimha's 'birthday lecture' on *Fluid dynamics research -- 10 years from now*

NAL's Flosolver Unit appears to be caught in a web of perennial change. Every month Dr U N Sinha is turning the place inside out, shifting tables, chairs, books, tea mugs, logic analysers and computers. Such frenetic activity is usually a sign that Dr Sinha is in the midst of another tryst with technology. It will be this *Pasteboard*'s privilege to report on Dr Sinha's latest rendezvous with success ... at some later date and time.

The present note is, however, to report on something that, to everyone's great delight, never changes at Flosolver Unit: the annual meeting to greet Prof Roddam Narasimha on his birthday on 20 July (for the record, he's now 66 -- a fact which must be stated because, looking at Prof RN, you'd never guess).

The lecture was at the unusual time of 12.45 in the afternoon, because the 66-year old gentleman was in the middle of another extraordinarily busy day. But the odd time was no barrier; RN's legion of admirers (and that number is growing all the time) turned up in large numbers to greet the master, and were rewarded with another splendid and insightful lecture. "Every lecture by Prof Narasimha is such a sublime and elevating experience. I would never miss one", Dr S K Saxena later said, echoing the predominant sentiment of the audience.

Prof Narasimha spoke on *Fluid dynamics research: 10 years from now*. Warning the audience that everything he was saying might turn out wrong ("our track record in such predictions is extremely poor: in 1990 we talked of cold fusion and warm superconductors, but not of the Internet!") the good professor said that we must still "try to predict".

After an illuminating, but rather brief, narrative full of homilies ("it seems that with the passing of a decade or century many things in history are naturally 'expected' to end -- even physics was thought to have 'ended' by 1900"), observations ("just one paragraph in a 1904 Prandtl paper, where he wrote about the boundary layer idea, summarized the entire foundations of fluid mechanics!") and introspection ("the problem in the next millennium will not be how to generate data; it will be how to make sense out of an endless deluge of data"), Prof Narasimha summarized his predictions on fluid dynamics as follows:

- fluid dynamics research won't end!
- high Reynolds numbers (Re) will still bring surprises
- A lot of modest Re might die; but it will continue to offer promising *technological* opportunities
- Computational fluid dynamics (CFD) will get increasingly industrialized
- Flow control will remain a central technical concern
- New 'convergences' (e.g. geophysical-technological) will emerge; they must be exploited.

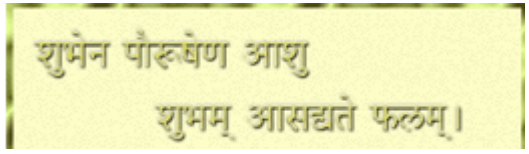
It is not for lesser mortals to make similar predictions; but we can hope and wish -- and ardently. So we wish Prof Narasimha many, many more years of fluid dynamics and happiness, of contributions to science and polity, and of simply *being* with us. He probably doesn't realise that his mere presence is like a shining beacon to so many of us. We all need inspiring idols to make our lives more productive and meaningful. So thank you, Prof Narasimha -- and happy birthday!

Srinivas Bhogle

Verses for the brave

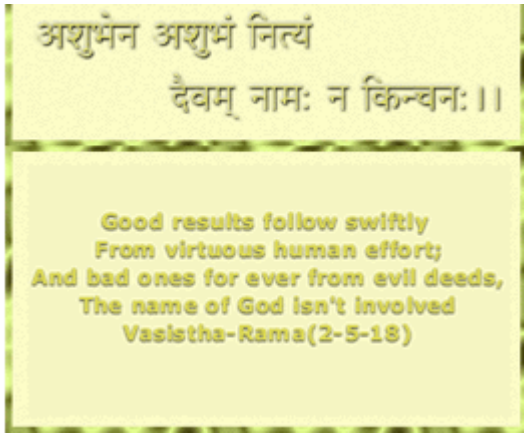
The title was intriguing. "I don't even want to guess what Prof Narasimha is going to talk about. But I am sure that it will be something illuminating and imaginative", Dr T S Prahlad, Director, said as he welcomed his illustrious predecessor for his "July Lecture" at NAL on 24.7.00.

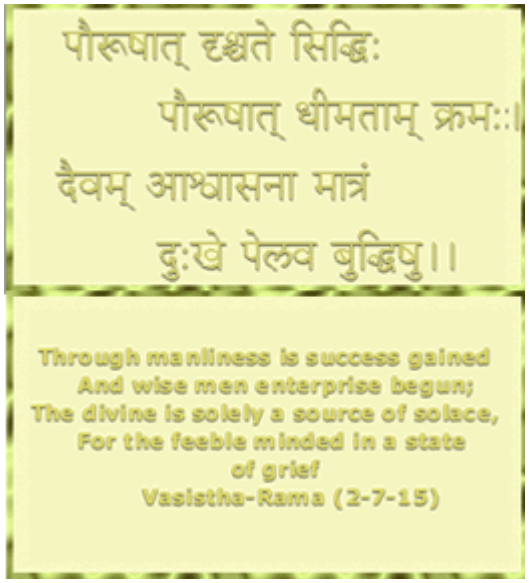
The "July Lecture" is delivered every year by Prof Roddam Narasimha just after he turns a year older (he's now 67), usually at the Flosolver Lab. Last year he spoke on *Fluid dynamics research: 10 years from now*; two years ago he spoke on *Cloud-like flows*. This year's title suggested a significant change of course; "could Prof RN be finally getting a little old?" we wondered.



Well, maybe. Actually it would be more correct to say that the good

professor is getting "older and wiser". What prompted Prof Narasimha to talk about his reading of the Sanskrit manuscript of *Yoga Vasistha*, believed to span an 18-day dialogue between Rama and the sage Vasistha, was the fact that it "strongly rejected fate". "I was struck by the articulation of such a different philosophy. It was also so forcefully expressed .. there was such verve, force, humour, lyricism and logic in the verses that reading them actually became a minor obsession with me .."





When a great scholar gets obsessed with a manuscript the outcome is usually a magnificent exposition. I have heard lectures by Prof Narasimha for over 15 years now but seldom seen him in better form. He began with samplers from the manuscript to introduce his viewpoint: *fate has been invented by fools .. the wise (prefer) manly effort*; or *absorbed in every little greed and dependent solely on fate .. they are meek, they are natural fools*, and then formally introduced the *Yoga Vasistha* ("a long philosophic poem which uses nested dialogues to narrate nearly 50 scattered stories -- about dreams, superhumans or reincarnations -- always with the objective of conveying a definite, forceful message"). This was followed by an account of one of the most popular stories from the collection: about how Queen Cudala first finds liberation and then helps her King also find it (I liked the stylish underplaying of what appears to be an outrageously amorous tale; the moral is "don't renounce the world, only renounce excessive attachment").
Finally came the *pièce de resistance* as Prof Narasimha actually discussed dozens of ("my biased selection of") verses from the *Yoga Vasistha*. The verses eulogize reason (*only by analysis: he has no other way*; or *sin -- so called -- is ignorance .. that analysis can slay*) and commend effort (*a bold man crushes fate .. with faith in his own effort*). Elsewhere the verses compare the past and the present (*the past can be swiftly overcome .. by manly effort in the present*) and marvel eloquently at the physical world (*like the blueness of the sky .. a mere lovely sensation*). There are also delightful instances of playful, but balanced, repartee between Rama and Vasistha which prompt the sage to exclaim *we shall between us .. make a fine pair indeed*.

For Prof Narasimha the *Yoga Vasistha* is notable for its unequivocal rejection of fate, emphasis on the value of analysis and effort, enthusiastic endorsement of participation in worldly affairs (nothing could be more reprehensible than retiring to the forest), rational world view, liberal view of gender, caste or nation and its invitation to a healthy *joie de vivre*.
There were many reactions as the packed audience poured out into the lobby after the lecture. For some (including this writer) the highlight was the brilliant (sometimes even mesmerising) prose in Prof Narasimha's English translations. I haven't heard him talk too often about "purple clouds decorated with little frills", about "splendour of perception in the belly of an atom" or, best of all, about a "cool gladness in the heart". A second reaction was to express admiration at how a hardcore scientist had embraced philosophy. But the most unusual view was that Prof Narasimha is now ready to become a human resource management expert ("see how forcefully he advocated the virtues of effort and reason!"). Most individuals are at the end of their tether when they are 67. How wonderful and reassuring that new doors keep opening for this remarkable gentleman. But as the *Yoga Vasistha* says somewhere: *human energy is what matters!*. We wish Prof Narasimha many more years of energy, passion and accomplishment.

Srinivas Bhogle

The (convective) lure of the tropics

Shouldn't we really be talking of "the (addictive) allure of Roddam Narasimha (RN)"? He's now 68, but the glow and charisma refuses to fade. A year ago, when he

spoke at NAL on *Verses for the Brave*, some of us thought that he's finally beginning to speak like a 67 year old. Certainly it was my private impression that RN is finally moving towards "softer" themes; rather like a Kapil Dev cutting down on his bowling speed, or a Lata Mangeshkar eschewing the high notes. His 2001 "20 July lecture" dispelled this impression. The original fire still burns within. RN might be heard talking more often these days about "digitizing India's cultural heritage", but "turbulent convection in the atmosphere" is still his first love.

$$L \equiv \frac{c_p \rho_0 U_*^3}{k\beta Q_*} = \frac{U_*^3}{kg\alpha w' T'_v};$$

But I do see one significant change. His prose is getting more lyrical. I have often thought that RN sacrifices flair for rigour in his writing and utterances. Thankfully, that appears to be changing; the romantic bottled up within is finally coming out. It was a pleasure to attend a technical exposition by RN which contained references "to the drama that is being played out in the sky - a drama featuring rains, squalls, storms and gales", and joyfully agreed that "the cumulus cloud is the queen of beauty in the atmosphere".

The lecture itself had two distinct parts. It began with a tribute to the tropics and made the important point that 300 years ago the tropical region was largely the land of prosperity, with plenty of sun, water and fertile soil ("today we perceive the region to be poverty-ridden and intolerably hot, but this wasn't always the case"). It then went on to argue why the tropics must be the subject of intensive study ("45% of the world's population stays here, and 45% of the land area is here") and finally talked of two very promising new research initiatives: the Indo-French *Megha-Tropiques* proposal to position a satellite exclusively to "watch" the tropics - to study water cycles and energy exchanges in the region - and the NAL-led New Millennium Indian Technology Leadership Initiative (NMITLI) for mesoscale modelling of the tropics and the monsoon.
In the second part, RN talked of some of his recent research work on the fluid dynamics of tropical meteorology. The tropics, he explained, are characterised by very small temperature gradients ('there isn't really a great difference between the temperature of Trivandrum and Delhi") and very low mean wind velocities ("we have occasional cyclones, but this is a region of very low winds"). We would therefore require new mathematical models for the tropics consistent with these meteorological observations. RN and his colleagues are very excited because they believe that they have a found a new formulation! "A great deal of what happens in the tropics in terms of the boundary layer and heat fluxes is best modelled by our weakly forced convection theory", he says.

While most of us lack the ability to join RN in his latest research excursion, we can certainly share his joy and applaud his achievement. Dr U N Sinha tells me that the new theory is uncanny and beautiful. "What we believed to be a strongly uncorrelated maze of atmospheric data suddenly gets neatly lined up!", he says. This is also great news for the NMILTLI and could be an important first step in the dream to build a supercomputer which will make the best weather predictions for India and the tropics.

As always, Prof Narasimha was warmly received at NAL by Dr Prahlad and his other "dear friends on the campus" when he arrived to deliver the lecture. "It's always a privilege to receive RN and marvel at his new interests and penetrating insights. This lecture is in fact his birthday gift to us", Dr Prahlad said. We wish Prof Narasimha many more years of scholarship and happiness. Perhaps his next July lecture should be titled *How to keep the fire always burning*. It is my impression that many of us would benefit from such advice.

Srinivas Bhogle

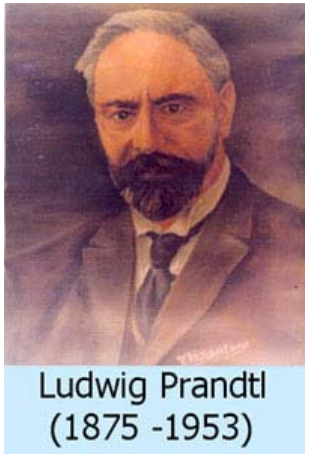
More Verses for the Brave

Our colleague Dr Rakesh Mohan Jha says that the moment will remain etched in his mind forever. There must have been many others in the audience who felt the same way on the evening of 21 May 2002 as Prof R Narasimha gave another splendid lecture, based on his reading of the Yoga Vasistha, in honour of Dr T S Prahlad, the day NAL's outgoing Director turned 62 years old.
The lecture was excellent, the occasion was special and the atmosphere in the new open air auditorium, lovingly created by Dr U N Sinha, Mr M Subba Rao and other colleagues -- which is soon to acquire a worthy name -- made it a remarkably memorable occasion.

Professor Narasimha is 70

It is a special pleasure to greet Professor Roddam Narasimha (RN) as he turns 70 on 20 July 2003. We wish him many more years of accomplishment, scholarship and good health.

An affectionate tribute to Ludwig Prandtl



For his "birthday lecture" this year at NAL -- on 20 July 2004 – Prof R Narasimha chose to pay a glowing tribute to Ludwig Prandtl. Talking of the famous boundary layer paper that Prandtl wrote a hundred years ago in August 1904, Prof Narasimha said that the "history of modern fluid dynamics can be traced to just one page of that paper".

I have heard Prof Narasimha speak for 20 years now, but seldom heard him pay such a warm and affectionate tribute. Prandtl is clearly one of his great heroes. In fact Prof Narasimha was so captivated by Prandtl's portrait, drawn by V M Ghatage for IISc's Aerospace Engineering Department, that he got it photographed so that he could keep it. "Now I see that the painting's lost or disappeared. We've lost a piece of history. I'm sorry I didn't steal that painting myself!".

Prof Narasimha called Prandtl an "engineering scientist"-- and with good reason. "I have no doubt that Göttingen – which was like a 'German Cambridge' those days – had better mathematicians, physicists and engineers than Prandtl; but Prandtl alone possessed that divine mix".

Prandtl was an avid observer. He spent a lot of time observing fluid flows. The endeavour was to understand ("in today's jargon, you could say that the approach was 'holistic'"). Prandtl was also 'minimalist'; he was always looking to see what would happen if he dropped a certain factor or effect from an experiment or equation. The quest was always to understand and explain the 'big picture'.

The lecture also contained some delightful insights of Prandtl as a human being. "There was no fuss about him, there was no fanfare … he always came through as someone very thoughtful and modest. Even his papers made no tall claims; the writing was supremely confident, but one never detects even a hint of arrogance".

Prandtl was a proud German. He never thought of leaving Germany even at the height of the Second World War. There was much speculation if he was a Nazi sympathizer, but it's more probable that he was merely naïve and innocent. Prandtl was also a devoted husband. He often asked his wife to read

out a book to him before bedtime; and, after his wife died, he continued to play her favourite tunes on the piano for her.

I've looked up the NAL archives and find that this is probably Prof Narasimha's seventh birthday lecture: he spoke in 1995 on the future of aeronautical fluid dynamics, in 1996 on cloud-like flows, in 1999 on the likely directions in fluid dynamics research a decade later, in 2000 on Yoga Vasistha's verses for the brave, in 2001 on tropical weather prediction and in 2003 on Indian sines.

Each lecture has been remarkable, and full of insights and scholarship. It is one of the joys of being in NAL that we can share the company of an "engineering scientist" who's so much in the Prandtl mould himself. We wish Prof Narasimha a very happy 71 st birthday, and we thank Dr U N Sinha for starting and sustaining such a wonderful academic tradition at NAL. We're already looking forward to Prof Narasimha's July 2005 lecture!

Srinivas Bhogle

Monsoon Raagas

Professor Narasimha's "birthday lecture" at NAL on 20 July 2005 was built around an intriguing poser: given that the climate in the tropics is 'forced' to a greater degree than the climate further north in the temperate zone -- that is more driven by instabilities -- shouldn't tropical weather be actually *more predictable* ?

Apparently, yes. But why, then, are we doing worse than the northern countries in weather prediction? Is it that we don't have enough observations? Or, that we don't understand the physics and the dynamics as well? Or, that we haven't 'tuned' the prediction software sufficiently well?

Nothing like a juicy problem to stir up our 72-year old professor! So the good professor goes adventuring again.

He begins his quest by attending a dance performance. He calls it the 'monsoon dance'. The performance begins with a 3D animation of the passage of clouds over the Indian sub-continent during the monsoon months of June-September 2003. After the intermission, it's the same 3D animation of the monsoon clouds for the next year, i.e., June-September 2004.

The professor plays this animation many times over to understand the plot better. Some things are immediately obvious: the clouds were significantly sparser in 2004 ... that fits with observation: 2004 was indeed a bad monsoon year, and 2003 was indeed much wetter.

Then he stares even harder at the imagery. Is there some discernible pattern as the clouds come dancing in from the Bay of Bengal and sail across the peninsula? Again and again, they return ... they apparently dance quite the same way, and then go away.

And is there some sufficiently significant northward movement visible? It seems that there might be, but the professor isn't really sure. He could try playing with the animation speeds to get more clues ... but he really wishes that there were more data!

But there's certainly something in the evidence ... there's already sufficient reason to believe that the behaviour in the tropics may indeed be *more orderly* . But if there is order, then we must be able to put a number on it.

The professor decides to confront the 'messy picture'. Is there a pattern? Or is it just random? He realizes quickly that it's the same question that's always asked about turbulent flows. He reflects momentarily on that old debate between fluid dynamicists and meteorologists. Is it basically a plume? If yes, can we demonstrate it?

The professor needs a tool, something like a magnifying glass that allows him to look deeper inside. Something that can separate this 'order' from the 'disorder' ... something that can see both the forest and the trees.
He decides to use wavelet transforms. Long before those MATLAB guys put it in, he, almost two decades ago, had recognised the potential and the power of the tool. He had even asked Dr B S Adiga and his NAL colleagues to give one of the first Indian workshops on wavelets. But that's another story.

The picture does indeed change quite dramatically after using wavelets. Suddenly hidden vortex rings leap into view ... sometimes we see whorls or filaments, sometimes we don't. But there's little doubt that the picture is now a lot clearer.

The excitement mounts. Historical evidence is unearthed (and, with it, memories of grandfather's tales about the terrible 1879 famine). Experiments are set up. Correlations -- for example, between sunspots and monsoon activity – are computed. There's almost too much data on view. The others are satiated, but the professor's rhapsody continues. He's briefly 42 years old again!

We indeed begin to see something. Not the complete symphony of the monsoon *raagas* itself, but the *suras* , at least, can certainly be comfortably spotted.

The final verdict is that there is indeed more order in monsoon rainfall than we have believed. We seem capable of accounting for about 40% of the variability.

The lecture ends. We almost wish that Prof Narasimha turned 73 instantly, so that we can hear his next lecture. But that's unfair. We want Prof Narasimha to savour every new day of his lifetime. And we shall savour, each day, his delightful presence amidst all of us. Happy birthday, Prof RN!

Srinivas Bhogle

The paradox in Indian "Aeronautica".

I remember Professor Roddam Narasimha speaking at the Bangalore air show in 2003. He seemed excited as he posed the question: "Can it be boom-time for Indian aerospace?". The general tenor of his talk that day was: "although I'm posing this as a question, I strongly believe that the answer is yes".

Three years later, it was again question time for the good professor. The title of his 2006 'birthday lecture' at NAL on 20 July was: "Aeronautica* is globalizing: Can India afford to keep out?". While the talk was, in many ways, an extension of his boom-time talk, the cheerful optimism had diminished. Prof Narasimha was now talking of an apparent "paradox"; that could be rephrased as: "when the basic fundamentals of Indian Aeronautica remain extremely strong, why isn't that boom coming?". He wasn't yet ready to shed his optimism, but he was clearly puzzled.

When a great mind is puzzled, and there's little doubt that our 73-year old is one of India's finest thinkers, the first instinct is to examine the data and the trends. The numbers weren't particularly encouraging. Indian science was dipping alarmingly ("even Taiwan has more engineering Ph.D.'s than India!"), the gap between India and the rest of the world in RD&D was widening, the quantum of "truly innovative" Indian R&D was rather low and India's performance indices in Aeronautica were significantly lower than even Brazil; China, of course, has streaked so far ahead that we will probably never catch up.

The picture didn't seem particularly rosy. "We don't seem to know how to exploit our potential and talent", Prof Narasimha said, and wondered if the endgame would feature a Western group "exploiting our talent the way we can't ourselves". There were other worrying thoughts: "why are we responding to Aeronautica scenarios as consumers? Why not as scientists and economists?".

Arguing that it would be suicidal for India to keep out of a globalizing Aeronautica, Prof Narasimha's prescriptions for the future were: (a) "integrate buy with make" (the Chinese drove a hard bargain before placing a big A320 order), (b) encourage public-private partnerships (so that projects are driven faster), (c) aggressively grow private small and medium enterprises, (d) leverage on defence purchases, (e) join multinational projects, but always with a view to build national capability, (f) make administration more flexible, and management more dynamic and aggressive and (g) nurture tomorrow's leaders.
It was therefore another remarkable birthday effort by Prof Narasimha, although he did appear puzzled to note how long his birthday lecture series, initiated over a decade ago by Dr U N Sinha, had endured: "Aren't all of you bored of me by now?", he asked.
If one looks at the growing audience that's turning up to hear Prof Narasimha talk, it would appear that he's doomed to continue this ordeal, at least as long as Dr Sinha is around at NAL. Actually these Narasimha lectures are now an occasion to celebrate, and

to warmly applaud a gentleman of exceptional intellect and charm. They don't make professors like him any more.

Srinivas Bhogle
*"Aeronautica", Prof Narasimha explained, was the conglomerate -- encompassing aeronautical S&T, civil aviation, certification, MRO, economic policies, industry, etc. etc.