

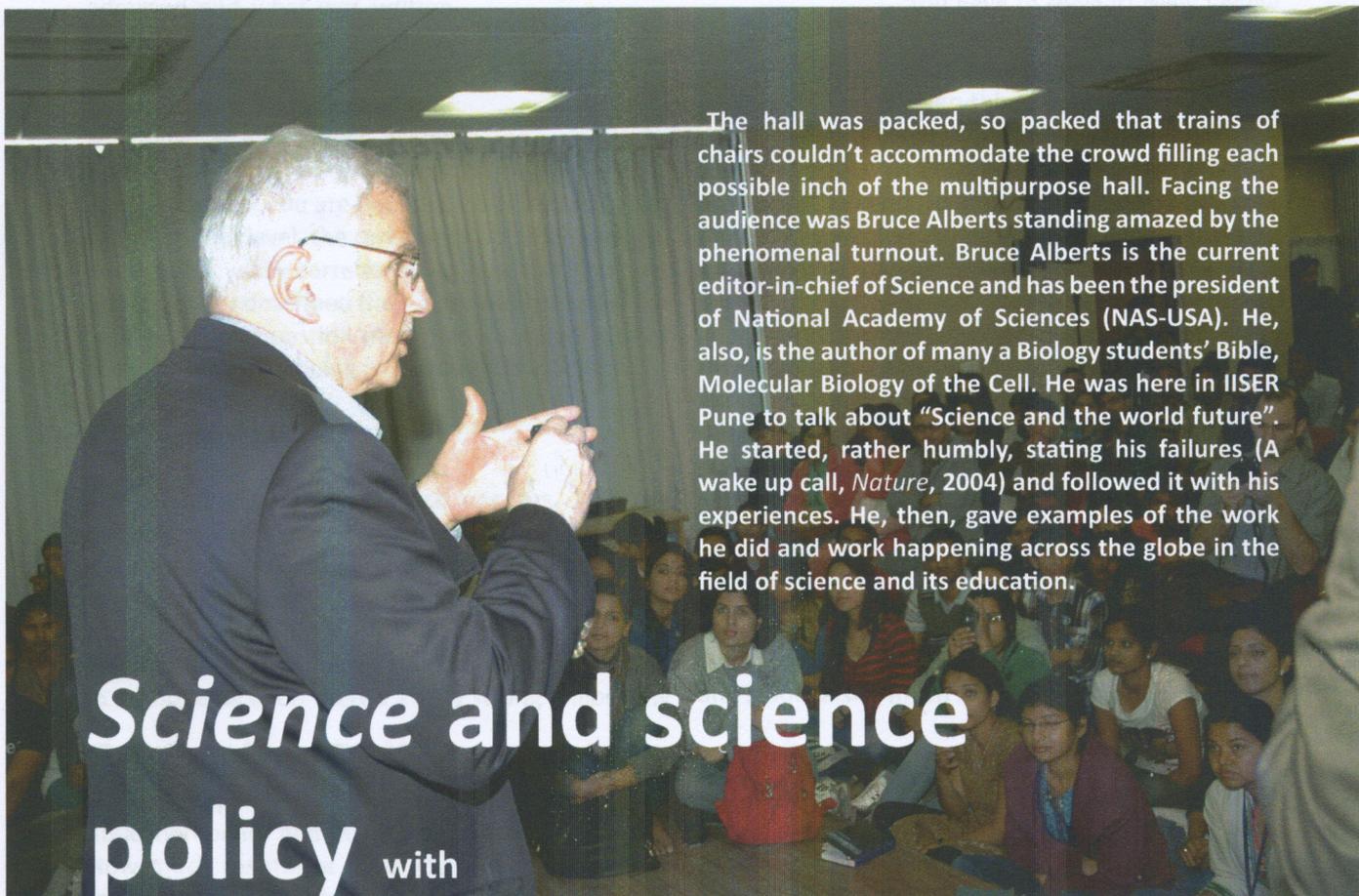
◀ 18<sup>th</sup> January 2012

## Colloquia with Prof. Michel Morange

**Prof. Michel Morange**, Professor of Biology and Director of the Centre Cavailles for History and Philosophy of Science at Ecole Normale Supérieure, Paris visited IISER for a span of five days. He

spoke about the challenges for 21<sup>st</sup> century biology (systems biology, synthetic biology, and the wedding between functional and evolutionary biology). He mainly talked about the fields and approaches in biological research that, according to him, are fading in importance like molecular biology (reductionism), and those that are gaining importance like interdisciplinarity. The focus of his talk was epigenetics and the possibility of it replacing genetics. One would think that audience might get bored after the week long lecture series by the same speaker but clearly otherwise was observed.

◀ 21<sup>st</sup> January 2012



The hall was packed, so packed that trains of chairs couldn't accommodate the crowd filling each possible inch of the multipurpose hall. Facing the audience was Bruce Alberts standing amazed by the phenomenal turnout. Bruce Alberts is the current editor-in-chief of *Science* and has been the president of National Academy of Sciences (NAS-USA). He, also, is the author of many a Biology students' Bible, *Molecular Biology of the Cell*. He was here in IISER Pune to talk about "Science and the world future". He started, rather humbly, stating his failures (A wake up call, *Nature*, 2004) and followed it with his experiences. He, then, gave examples of the work he did and work happening across the globe in the field of science and its education.

## Science and science policy with

# Bruce Alberts

We had an opportunity to speak to Bruce Alberts and ask him to share his experiences and views on a range of topics. The questions went both ways with him asking about our experiences too. The memorable session touched topics like the education

and examination system, policy; its makers and its making, students and teachers, and more. Read the following where Siddharth (SBI), Sachit (S), Alisha (AP) and Rachana (RB) and Bruce Alberts (BA) discuss their concerns and opinions.

## Science and its education:

[While answering BA's question about the selection and background of students in IISER...]

SBI – And what you were referring to – a single exam making a big impact on one's education – the same problem exists here.

BA – In a college, one of the faculty members conducted a study a long time back. He asked the faculty of the college, who were the bottom 5% of their PhD students and who were the top 5% and he made a list of these. He studied what they had done in their exams before they were admitted and what was written up about them in the interviews and why they were taken. And he found that there was no correlation at all with exams, exams have nothing to do with how good a scientist you are (laughs). So if you do better than a certain level, the rest makes no difference you know. What really correlated was how the interview went – if they described their work well, or asked the faculty a good question then that went very well in their favour. He's hoping to publish this in Science.

BA – So what're these exams like?

SBI – Multiple Choice... Quick answers. And the national board exams are a different matter. As in, they are corrected by different teachers all over the country. They're very difficult to standardize.

S – They are heavily biased toward memory. In India, in school education there's a very strong philosophy

## Education Policy:

S – You've spent a long time in setting or advising on education policy and making evidence-based policy. How much resistance have you faced from policy-makers when you show them that this is what's happening and that it just doesn't work?

BA – So the trouble with politicians is that they're only looking at the next 2 years and many things that science tells you is that you have to plan for 10 or 20 years. And even if they actually accept the fact that it will be a better world in 10 years if I do this thing, the thought comes that "Am I going to get elected because nobody is going to know that?" So they try

of "There is one and only one right answer." "There's one and only one right way of expressing it."

And after you come to a place like IISER, the first two semesters of undergraduate education is unlearning everything you've learnt. There's clean up. Suddenly, there's "Ask your own questions".

BA – That's very interesting. That fits with many things I've seen in the United States. If education is teaching you that there's only one right answer, then all you need to do to be educated is to know the right answer. But then what happens when you have a new problem, a real problem in life? You have to solve it! Well, I know that in countries like Japan where they have a very critical exam for everything, naturally it just ruins your education system. Students spend all their time cramming for an exam. It's very miserable. And once they succeed, they go to college and they don't want to do anything else. (laughs) They're sick of education. They want parties.

AP – It happens across India as well. When we start in school, we all love science. And by the time we're done with school, the proportion of science lovers just drops exponentially. Why do you think this is so?

BA – Yeah, they hate it and I would hate it too! Because mostly you're just memorizing. If they had the kind of education that you are having in college, it would do good for them. But science that is defined as memorizing names of things or what scientists have learnt and studied isn't much fun.

these short term things. Often these go out with a boom. They are not for the long term but it gives them more votes. This is a real problem. So with all our sophisticated public, caught up by issues like climate change which we face in the United States, people need to make sacrifices in their personal life and their lifestyle to do something about climate change. But if you tell a politician to tell somebody that... If people don't actually understand what the science says or whether they should believe it, they'd rather not make any sacrifice than do something that scientists say is good for their grandchildren. Because they don't understand how science works and they think

"Oh can I believe that or can I not believe that?" So in the United States people are usually confused by politicians who make simple arguments about why, for example, climate change is not a problem. - Its better if it gets warmer, it's too cold right now!

SBI - So, in your 12 years at Washington, were you able to affect some change on these perceptions?

BA - Yes. So the way it works in the United States is that the Academy makes its reports and then often the people on the committee are asked to testify in

## Educating the world:

SBI - What do you think is the single most important thing to change to make that process faster?

BA - Well, if you have an educated public and a democracy that can't be fooled and that understands what science is and that respects scientific judgments and that could put pressure on politicians that we need this... I mean, it's never going to be perfect (laughs). And right now, we have this kind of situation in our Congress that you have in your Parliament, where basically the major party is trying to make the other party look bad. And to me, all they want is to win the next elections so in the process they're damaging the country so I would say that this is anti-patriotic even though the Republican Party now says "We're for America" but they're actually hurting America in order to win votes for the next elections.

AP - Now, speaking about education of the public, how do you begin? Do you start with educating people first or do you educate the teachers first?

BA - Well, you can't do anything without teachers. Teachers are critical because there are not enough scientists to do the education and we don't know how to do it really. I think there should be a major focus on teachers.

Finland is a great example. In 1970, they started a major change in how they train teachers, how they

Congress about what they've found. We also have lots of NGOs working on the environment or on health issues and they are very active in lobbying Congress. They use Academy reports very effectively. They say, "The academy says this and that and so you have to pay attention." That makes a difference. But often it takes a long time between everybody recognizing what is right and them changing the law. Compromising between the different lobbies takes a lot of time and effort. Eventually I think we will do the right thing but it'd take 10 or 20 years.

reward teachers, how they treat teachers and how they select them. They took 25 years to start to see that having a powerful effect. And right now Finland is doing very well because they have a really good teacher core.

In the United States, a lot of our PhD students who finish in science - some of them would be interested in teaching at lower levels but the system into which

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they would be going is not very supportive. They don't want to work in a system where people do not reward excellence and where orders are given from the top of the system that doesn't make sense. That is where they as outstanding teachers wouldn't have a voice in changing or improving the system.

You have, I think, a similar problem in your State Universities. You need a lot of good scientists to go and be Professors at State Universities. But so long as State Universities are not well run, and don't reward merit and don't keep on improving, and if they don't

have the ability to work there and do something important for the university and for the students and to be treated well, people are not going to go.

So I feel that our problem is at the pre-college level where we know that the main reason good teachers leave is not because of how much money they're making, but because they're not respected and they're told or given orders to do things that don't make any sense and constrained by certain tests and those kinds of things.

I was amazed to discover that in Indian states when the Governor changes and the party changes, they change the Vice Chancellor. And then of course if you give the vice chancellorship to someone who is not chosen on the basis of their ability to really be a leader in education but on some other basis, then that person appoints other people and the whole thing decays below him or her.

AP – How are things different in the US? Is there any system we can adopt here to improve matters?

BA – All the State Universities in the United States have Boards of Regents, a group of distinguished people who care about education. The Governor appoints some fraction of the Board of Regents as they turn over but the Board of Regents has a longer life time than him. So most of the Board of Regents is from a previous set of Governors. And the Governor can't change the Chancellors because it's only the Board of Regents that can do that. So that insulates

## Examinations:

S – We'd like to change our education system to meet better standards, to make a more scientifically literate public. This will require large changes in the way examinations and teachings are carried out. What kind of resources do you think are required, for example, do we have to pay teachers more? What is the best strategy to make the change happen?

BA – Well, I think that the main problem with teachers is not the pay but the work conditions and so that's easier to fix than the pay. I think that changing the exams is the most powerful thing you can do. I've seen the last 12 years or so after the 'No Child Left Behind' policy drove everything in the wrong direction by making testing for teachers in schools that was of the wrong kind, the cheap kind. They want to spend 1 dollar a student for testing them. And for 1 dollar a student, they save some money but they ruin the system. There was a study that I was on with a 'President's Council of Advisors in Science and Technology' (PCAST). It's all on the website of PCAST. They made this recommendation - Change the nature of the exams and you will change the nature of the teaching. They calculated that a good exam would cost about 45\$ per student, not 1\$ a student because it would not be multiple choice. It would be written, comprehensive reading...

the universities from the politics- which is incredibly important. It seems like a simple idea for India to do this but it's complicated.

I have heard cases in India of deans being related to politicians or strongly influenced by them – that's a disaster for the future of India. I don't know how you'll change it. If one state takes this as an experiment and shows it makes a difference then the other states would try to compete.

This is one thing I learnt to appreciate about the US from my travels around the world, all our universities are completely merit based. Many highly developed countries also have these problems that you have here. At a Frontiers of Science Conference I attended, the co-chair from the UK was a brilliant young Italian physicist from Cambridge. He told me he's in Cambridge because he couldn't get a good job anywhere in Italy since he didn't know anyone. So that's a really critical issue here because the teachers produce the next generation. Also that tradition is really something that people should be working on.

all that stuff. This committee recommended that the Federal Government subsidise states because everything lies in what the states did. The idea is that the test development process is expensive if you do it right. If you're testing by multiple choice then it's not so expensive.

AP – How do you define a good test?

BA – A good test is one that drives good teaching and learning. So they're much more complicated. If you look at the NAEP (National Assessment of Educational Progress) website, you'll see material on this. It was lead by Rick Shavelson, formerly the dean of education in Stanford University. He spent his life on science assessment. It's not easy, I mean, I couldn't make a good exam. Getting the people who work in science assessment together with the best scientists, that's my dream; to make really outstanding assessments and then - like scientists - we test the effect of these assessments on science teaching and learning, and use this to feedback into the development of the test. But that's not what we usually do in education. Education is sadly too close to politics, and politicians like simple answers. They didn't realise all the horrible things that would happen with the "No child

**“Well, I think that the main problem with teachers is not the pay but the work conditions”**

left behind” policy. “I used to A from Company B.” What will you do 5 years from now when the AP – Don’t you think there is a huge hype for the whole term “test”? No three hour examination, no one day examination can determine the ability of a child sitting in examination hall.

BA – That’s right. So we mostly talk about only a summative assessment that we use at the end of the course. We’ll talk mostly about course exams not national exams, mostly because that’s what’s driving

most of us. There’s also a different kind that has developed – Formulative exams that you give during the course of a semester of teaching. So you find out what the students know and don’t know. I’m talking about teachers actually knowing when their students have understood something or not. And also by those kinds of tests they can tell the students what they really want them to know – We don’t want you to memorize, we want you to think. You’ll see that in the PCAST report.



“We don’t want you to memorize, we want you to think.”

## Papers and their audience:

SBI – The way research papers are written has changed greatly over say the past 50-100 years. What do you think are the major changes in the way papers are written and is that reflective of a change in the way science is actually happening?

BA – Its probably different in different fields, I’ll only answer for Biology. I think that the critical thing is writing all the methods and making them available so that people can use them. We’re losing a lot of that now. People are lazy about describ-

ing their methods - "I used Kit A from Company B"... What will you do 5 years from now when the company no longer exists? There's really no excuse now as you have space for supplementary material available online. Time and again when I'm teaching students from papers, we can't figure out what they've done.

I think there's lot more pressure on publishing quickly which makes papers less interesting. Papers used to be longer too. So now there's this whole write short, get it out fast attitude... But that's because of lots of competition in overcrowded fields. I tried to get *Science* magazine to be more effective in getting methods clear. Scientists need

to know how to write better. I find many scientists cannot write an abstract that people outside their immediate field can understand. We keep sending it back and eventually we just have to rewrite it. There's terrible communication. So we're losing something.

*Science* has a huge readership and a large enterprise and it's completely different from what it was 50 years ago. When I was your age, I knew everybody working in my field. Nobody is worried about stealing things because if you did that nobody would ever talk to you again. That was the network. But now it's so big! Nobody knows anybody! It's got some disadvantages.



## Paid research:

SBI – Finally, we just wanted to know your views on policy that could combat paid research, like Exxon funding climate research?

BA – So we have lots of declarations of conflicts of interests, and we've tried monitoring that. People don't believe stuff that comes out completely contrary to what everyone else is saying. Politically

motivated research isn't very effective in changing people's minds. Its used by the politicians to try and confuse people. The scientists are not confused by them. I think most places in the United States will not let you take money from places where there is any restriction on publishing what you find.

## Off the rack:

AP – Now a question on popular demand. Do you have any other hobbies other than pure science?

BA – Yes, reading history, biographies. I don't like fiction. I like non-fiction like history of different periods or battles of people or good biographies.

spoke about the challenges for 21<sup>st</sup> century biology (systems biology, synthetic biology, and the working between functional and evolutionary biology). He

RB – You surely have traveled around a lot. So what's one place that you will always want to revisit?

BA – Of course, India! What did you think! I've been to India 25 times. 10 times before I even came through the Academy. My wife's now on a bus up in North-East India, and has been here more times than me.

◀ 25<sup>th</sup> January 2012

## Colloquia with Prof. Jagdev Singh

This Wednesday, we saw **Prof. Jagdev Singh** of the Indian Institute of Astrophysics, Bangalore giving us a talk on the solar corona and the ADITYA-1 mission. He spoke about the physical and dynamical characteristics of various coronal features, coronal observations

and role of various physical processes in heating of the coronal plasma. It was a very interesting colloquium and was a treat for all the aspiring astrophysicists of IISER.

◀ 26<sup>th</sup> January 2012

## Republic day



Photo by: Nisarg Desai