Hype about the human genome

Have we missed the bus?

PRAFUL BIDWAI *from New Delhi*

The real question is how countries like India (or Bangladesh, Brazil or China) should allocate scarce resources to the natural sciences. With their present biological expertise, they can't be world-class HGP participants. They can always join the effort later… It makes more sense for them to consolidate their basic biology. They must collect a bank of problems along with possible solutions. Science doesn't proceed in a vacuum. It works best when it sets itself problems.

THE publication of the first results of the Human Genome Project (HGP) has electrified the world of biology - not least thanks to the speed with which millions of complex codes were cracked. Speculation about the "Book of Life" is pregnant with possibilities in fields like drug development and bioinformatics.

The HGP - actually two projects, a public-domain international consortium and the private sector Celera Genomics (US) - has spawned media hype too. "Man has superseded Darwinism," we are told. Science has given humans the ability to snip and stick the threads of life called DNA (deoxyribonucleic acid). A 30 year-old could drink a protein cocktail and remain young forever.

Genomics will open up great vistas, this argument runs. India missed the Industrial Revolution, and then, almost, the Information Revolution. But it mustn't miss the genome bus to the Brave New World. We have 800 biotechnology companies, and a vast pool of scientists. We also have the world's most ethnically mixed human population.

On this view, India could be a world genetics leader. Shamefully, it didn't join the HGP consortium - unlike China. But it isn't too late. The government has just announced Rs 100 crores for genome-related projects.

Alas, such prescriptions bear no connection to reality. It is simply invalid to contend that India has "missed the genome bus." This option was not available to it at the existing stage of biology expertise. The world is still years away from commercial exploitation of genome-related discoveries. We must not run after glamour and delude ourselves we can master the field by leapfrogging.

Seen in perspective, the HGP has revealed a lot that's new. The Book of Life is like a dictionary with thousands of "words" linking the four chemical bases of all genes - a, t, c, and g.

Last June, the international consortium announced 90 per cent of the letters. It has now produced the first readable text - somewhat chaotically arranged and without detailing the words' meanings. Some main findings:

* The human genome contains 30,000 to 40,000 genes - much less than the originally expected 100,000-plus, or about the same number in a mouse, or only twice as many as in a worm.

* Human beings share a huge 99.99 per cent of their genetic material - across races and ethnic groups. Of 10,000 genetic sequences cracked, only one differs between blacks, whites and browns.

* The difference between human and other life forms lies not in the kind or quantity of genes, but the way they are arranged. Human genes are organised like urban clusters separated by "deserts" of "junk" DNA. The gene-map of, say, the roundworm resembles evenly spaced "suburbs."

* Humans are thrifty with their genes. They can get them to do much more than other species, producing three different proteins with each, rather than just one. Our genes can generate a lot of complexity with just a few extra proteins.

* Our genes have different segments. Some act like "switches" to make different proteins. We still don't know how the switches work.

The HGP greatly extends biology's reach. But it also illuminates areas of darkness. All information from the international consortium is available in the public domain with no bars on their use and distribution. Third World scientists have accessed it more than 300,000 times, including 160,000 times in India.

However, this work is incomplete. All talk of "mastering" Nature is boloney. True, thousands of genes have been identified, including more than 30 that play a role in human disease - out of thousands. But science still can't identify, leave alone manipulate, most such genes.

"It's as though we have climbed to the top of the Himalayas. We can for the first time see the breathtaking vista of the human genome," says Eric Lander, of the Whitehead Institute. However, the HGP has many gaps and ambiguities. Scientists hope to fill them up by 2003. But, says, Lander, "we've got a long way to go…"

Could Indian scientists have joined one of the 16 collaborations within the HGP consortium and achieved a breakthrough? This is like asking if India could have joined the Apollo project leading to man's landing on the moon.

Apollo was far too advanced for India. Joining it for prestige would have massaged Indian egos, but not helped Indian physics or material science much.

The real question is how countries like India (or Bangladesh, Brazil or China) should allocate scarce resources to the natural sciences. With their present biological expertise, they can't be world-class HGP participants. They can always join the effort later. As of now, its results are available free.

It makes more sense for them to consolidate their basic biology. They must collect a bank of problems along with possible solutions. Science doesn't proceed in a vacuum. It works best when it sets itself problems.

India's own past warns against rushing into genomics. We set up a biotechnology "mission" 13 years ago with (incongruently) Operation Blackboard, Superconductivity, etc. Numerous vaccine projects were included in the "mission", to be completed within three to five years.

These were abandoned. Rs. 500 crores vanished in superconductivity without a trace. Our experience with IT, our greatest technology bubble, also counsels modesty.

In India, only 20 to 25 companies have real familiarity with contemporary biology. Only two of them (Shanta Biotechnics and Bharat Biotech) have developed commercial products. Most of the rest - in pharmaceuticals or seeds - are merely reproducing their principals' products. There is little innovation.

Even our universities and laboratories have a long way to go. The labs doing competent molecular biology number only about a dozen. Their annual output is 30 to 40 standard papers - roughly double that of a good Western university.

It is foolish to imagine we can leapfrog to a miracle. Even to leapfrog, you need the solid muscle of biology in the hind-legs.

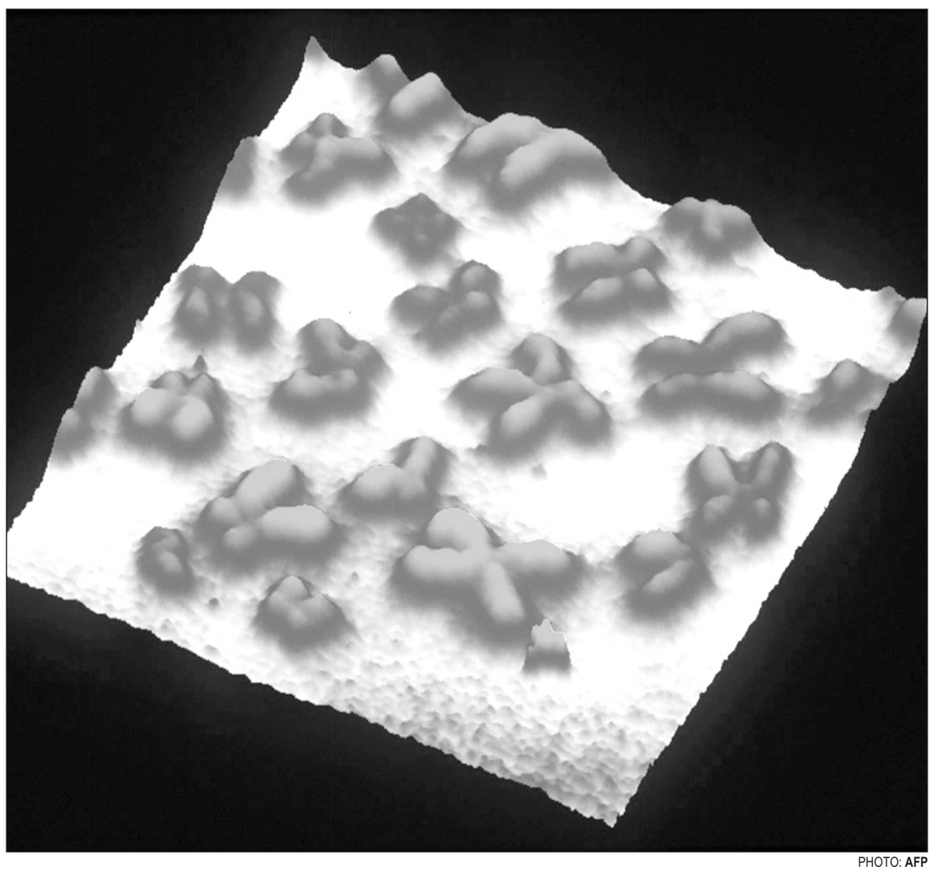

PHOTO: AFP

A computer-generated handout of human genome.

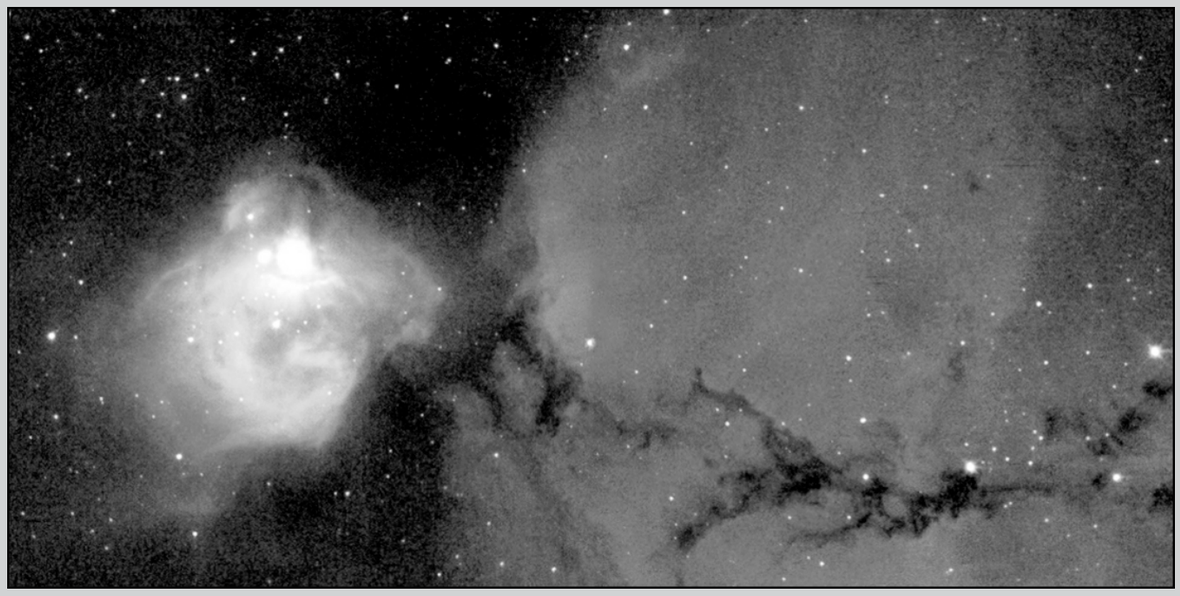

PHOTO: AFP

The stellar nursery

This Hubble Telescope image, released March 28 by NASA shows newly born, ultra-bright stars blowing a glowing spherical bubble caused by extremely intense radiation in the nebula N83B, also known as NGC 1748. The image graphically illustrates just how these massive stars sculpt their environment by generating powerful winds that alter the shape of the parent gaseous nebula. The apparently innocuous-looking star at the very centre of the nebula, just below the brightest region, is actually about 30 times more massive and almost 200,000 times brighter than our Sun. The intense light and powerful stellar "winds" from this ultra-bright star have cleared away the surrounding gas to form a large cavity. The bubble is approximately 25 light-years in diameter - about the same size as the famous star-forming Orion Nebula. The Orion Nebula is sculpted by intense radiation from newly born stars in the same way as N83B. Astronomers estimate that the spherical void in N83B must have been carved out of the nebula very recently - in astronomical terms - maybe as little as 30,000 years ago.

How a star is born

Clouds lift on missing link

ROBERT ROY BRITT

USING a surprisingly simple technique, astronomers have illuminated a missing link in our understanding of the earliest period of star formation.

Stars develop out of cold dark clouds of gas and dust spread throughout the cosmos. But the gas is largely undetectable, and the dust makes it impossible to see what's going on inside these clouds. It's akin to studying the Invisible Man from behind a wall.

So while much has been learned over the past two decades about stellar evolution, as well as the interior of full-blown stars, their birth remains mysterious.

Seeing through the problem

But an international team of researchers has figured out a way to peer inside interstellar clouds by looking through them. The technique involves focusing on light from more distant stars.

Looking at one relatively nearby cloud in this way, they measured the amount of starlight absorbed by various regions, and then calculated density and temperature differences from the core to the outskirts. The results show an object on the verge of collapse.

A star is about to be born.

"These measurements constitute a major breakthrough in the understanding of dark clouds," said João Alves of the European Southern Observatory. "For the first time, the internal structure of a dark cloud has been specified with a detail approaching that which characterises our knowledge of stellar interiors."

Alves, along with Charles Lada of the Harvard-Smithsonian Centre for Astrophysics and Elizabeth Lada of the University of Florida, discuss the work in the January 11 issue of the journal *Nature*.

What's known

Interstellar space is a misnomer. In fact, the area between stars is laced with gas and small dust particles. In places, this stuff collects into clouds, called nebulae. A typical nebula is about 74 per cent hydrogen, 25 per cent helium, and one per cent heavier elements.

The temperature and density of a nebula determines whether it can become a stellar nursery or not. By nature, gravity works to pull the gas and dust together. But, by virtue of its activity, the material also exerts an outward pressure. The warmer the material, the more active it is, and the more it pushes outward.

In certain types of nebulae, where the temperature is cool enough, the force of gravity overcomes the outward pressure. The gas and dust becomes more tightly packed, and eventually a gravitational collapse occurs.

In this way, one or more clumps form. Scientists call them protostars.

And if all goes well, the battle between thermal pressure and gravity transforms a protostar into what scientists call a main-sequence star. For this to happen, the temperature has to rise enough at the core of the object to jumpstart thermonuclear fusion, which converts hydrogen to helium and powers all stars, including our Sun.

The heat from this burning creates thermal pressure, which keeps the bulky mass from collapsing under its own weight. Balance is created, and the star can shine for billions of years.

A Bok globule

The Alves team studied a Bok globule, a type of nebula or dark cloud known for its small size and compact, nearly spherical shape. The object, called Barnard 68, was a good candidate for study, having a particularly simple shape and well-defined edges. It is also relatively nearby, just 410 light-years away.

The cloud contains about twice as much mass as our Sun, but of course this mass of gas and dust is widely distributed: Barnard 68 covers an area about 12,500 times bigger than the distance from Earth to the Sun. The cloud, therefore, is many billions of times less dense than the air you breathe.

Still, the stars behind Barnard 68 are mostly obscured, their light scattered by dust. The effect is similar to what makes a sunset on Earth appear red. Blue light, having a short wavelength, is the most scattered and doesn't get through while longer-wavelength red light passes through more easily.

Barnard 68 is dense enough, in fact, that if you could reshape it and slip it between us and the Sun, Earth would be plunged into eternal darkness.

Turning on the lights

Using large telescopes with sensitive instruments at the La Silla and Paranal observatories in Chile, operated by the European Southern Observatory, the research team made long exposures that revealed 3,708 background stars. The light of surrounding stars - those not obscured by the cloud - provided a basis for estimating what the light should have looked like from the obscured stars.

By measuring the actual colours of these stars, after their light had been scattered by dust, the scientists calculated the amount of dust in various parts of the cloud, which also tells them how much gas is present, because gas and dust are known to stick together.

They found that the density of Barnard 68 increases steadily from the edges to the centre, which indicates a fine balance between gravity and thermal pressure. The balanced physics, they note, is much like what's found in a main-sequence star.

But this balance is tenuous, they said.

Barnard 68 appears to be at the beginning of a collapse, expected to take place in about 100,000 years. If things work out, a new equilibrium will be achieved and a new star - one very similar to our Sun at its birth several billion years ago - will grace the heavens.

Source: Internet

Time to count the food miles?

As France clears up after yet another round of storms, continues to mop up after chemical and oil spills and struggles with pu blic panic over the latest mad-cow scare and foot-and-mouth disease, the French, finally, are beginning to wish they had been a little more attentive to environmental matters a lot earlier, writes Sally Zalewski

AS part of the worldwide great globalisation scheme of things, France has kept up with the best of them. Over the past 20 years, out of town shopping malls have sprung up everywhere. The idea was that these ugly constructions would not obliterate the beauty of villages and that people could shop more easily. Easy access by car, easy parking and everything under one roof. However, getting to these out of town centres needs a car, which obviously needs petrol, and although the ugliness of these constructions is not spoiling the landscape, these same villages are dying because they have lost their trade. Even the scared village bakers are closing down.

In France, as in most other European countries, rural villages are dying. Small shops cannot compete with large supermarkets. While Europe continues to bemoan the effects of climate change, due to greenhouse gases (such as are produced by car exhausts) and devastating crude oil spills in its seas, little is said about cutting down on food miles. Food miles to get food to shops and food miles to drive the consumers to the shops to buy the food. And what if an effort was made to cut down on food miles and eat more locally produced food when, and if, it was in season?

Within the European Union many of the food miles are on the road. Not only does this transportation add to traffic pollution but the intensive farming methods favoured by Brussels have greatly reduced employment (down from 18 million to seven million jobs in 25 years Europe-wide) and contributes massively to the destruction of nature. Today, 80 per cent of European subterranean water supplies in farming areas contain nitrate levels which exceed EU safety limits; 26 per cent of water used in many EU countries is for agriculture, rising to a staggering 80 per cent in some countries such as Spain.

According to the conservation organisation WWF, European Agriculture and Rural Development Programme, an average of 700FRF (USD100) is taken from every European tax-payer to finance the Common Agricultural Policy (CAP) which greatly damages the environment by polluting fresh water reserves, diminishes fertility of the soil, devastates natural habitats and endangers wildlife species. As Natacha Yellachich, the WWF European Agriculture Coordinator, points out: "Farmers should certainly not be receiving taxpayers money to wreck the environment, but on the contrary, they should be rewarded for providing what society seeks; namely healthy food which has been produced by respecting the beauty and the diversity of the countryside. This is why more money should be invested in agro-environment policies."

With recent numerous food scares, organic food is being heralded as the saviour of the crisis. France and the rest of Europe is simply not yet capable of meeting public demand and much organic produce is imported from distant countries. Even more food miles. The situation is further exacerbated by the fact that the consumer no longer seems to have any notion about what season it is. As our supermarket shelves groan under the weight of imported out-of-season produce, such as strawberries from Chile in January, it appears to be of little public interest to contemplate the amount of environmental pollution being generated.

And meanwhile the organic battle rages. Is the increased price justified? Is it healthier? Does it taste better? Conservationists are confident that organic farming is healthier for the environment, but it would be even healthier if food miles were reduced.

But organically grown food is fast becoming like all other industrially grown crops - only the big and the wealthy can survive. The official organic label is prohibitively expensive and many small growers simply cannot afford it. Because they cannot afford this official organic blessing they cannot sell their produce for the price it deserves. Many become disenchanted, go bankrupt and close down, crippled by bureaucracy and health regulations.

There may yet be a sliver of a silver lining to the mad cow cloud that has descended over France. Far more people are actively seeking out more environmentally friendly foodstuffs and, above all, shoppers are returning to the local butchers. The French may save petrol on returning their custom to neighbourhood shops, but this does not necessarily mean that they will walk - 50 per cent of car trips in France involve an average distance travelled of not more than 3km.

- WWF feature

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