R.N. 70269/98
ISSN : 0972-169X

Postal Registration No.: DL-SW-1/4082/06-08
Date of posting: 26-27 of advance month

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DREAM 2047

November 2008 Vol. 11 No.2 Rs. 5.00

Destination Moon

Inside

... think scientifically, act scientifically... think scientifically, act scientifically... think scientifically, act...

Destination Moon

The Moon occupies a unique place in our daily life - be it poetry, literature, religion, or time-keeping. Indeed, our fascination with the Moon is as mysterious as the Moon itself. The Moon has the history of the early solar system etched on it. Understanding the Moon, therefore, provides a pathway to unravelling the early evolution of the solar system and that of the planet Earth. Indeed, the first ever scientific observation of the Moon was made by Galileo 400 years ago when he used his new invention - the telescope - to observe mountains and craters on the lunar surface. The era of space exploration began in 1960s; that is when observations of the Moon received a boost with fly-bys, orbiting and landing of space probes, and finally manned missions. Indeed, the fascination with the Moon continues to grow, as can be gauged from the fact that several countries – including India – have planned missions to the Moon in the near future. It now appears that a permanent human base on the Moon could be a reality in not too distant a future.

The first man-made object to fly by the Moon was the Soviet probe *Luna* 1 in January 1959. *Luna* 2 was the first probe to reach the lunar surface in September 1959, though the landing was hard. *Luna* 3 in October 1959 photographed the heavily pock-marked far-side of the Moon thus indicating significant differences between the two lunar hemispheres. It was in February 1966 that the first ever probe, *Luna* 9, soft-landed on the Moon and transmitted pictures of the lunar surface. The United States launched a series of parallel orbiting and landing missions in their *Ranger* and *Surveyor* series. Humans landed on the Moon on 20 July 1969, when Neil Armstrong, commander of the American Mission *Apollo* 11, set his foot on the surface of the Moon. The last man to walk on the Moon was Eugene Cernan during the *Apollo* 17 mission in December 1972.

The first robotic lunar rover to land on the Moon was the Soviet *Lunokhod* 1 in November 1970. Moon samples were brought back to Earth by the three Soviet missions (*Luna* 16, *Luna* 20 and *Luna* 24), and the US *Apollo* missions 11 through 17, except *Apollo* 13 which was forced to abort lunar landing. It was during this period that detailed analyses of dust and rocks brought back by *Apollo* and *Luna* missions were made in over 100 laboratories throughout the world including India. The studies also included lunar surface processes based on direct measurements using instruments placed on the Moon and also on-board lunar orbiting spacecraft.

After a lull for nearly two decades, there has been a renewed interest in lunar science. Imaging system on board American *Galileo* mission sent pictures of some of the unexplored regions of the Moon. *Clementine* and *Lunar Prospector* missions of USA carried out photogeologic and chemical mapping during 1991-98. Galileo identified a large impact basin, the South Pole-Aitken region on the far side of the Moon, which could not be recognized by the earlier missions because of its extremely subdued profile. In 1994, the *Clementine* mission photographed most of the lunar surface in ultraviolet, visible, near infrared and long wave infrared bands, thereby providing the first global data sets for lunar gravity, topography and multi spectral imaging. These results enabled global mineralogical mapping of the lunar surface. The *Lunar Prospector* carried a number of sophisticated instruments on board. Apart from preparing chemical maps of the Moon for elements like thorium, potassium, samarium, iron and aluminium, it also identified the presence of hydrogen-bearing compounds, probably water, in the permanently shadowed north and south polar regions of the Moon.

In recent times, the European Space Agency launched European spacecraft *Smart* 1 in September 2003 to survey the lunar environment and create an X-ray map of the Moon. Japan has a lunar orbiter *Kaguya (Selene)* in flight, launched in September 2007. China has *Chang'e* 1 orbiter launched in October 2007. The *Lunar Reconnaissance Orbiter* of USA, scheduled for lift off in April 2009, is designed to map the surface of the Moon and characterize future

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Published and Printed by Dr. Subodh Mahanti on behalf of Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi - 110 016 and Printed at I.G. Printer Pvt. Ltd., 104, DSIDC Complex, Okhla Industrial Area, Phase-I, New Delhi-110 020 **Editor : Dr. V. B. Kamble**

100th biography of scientist in DREAM-2047

Martin Ryle

A Pioneer of Radio Astronomy

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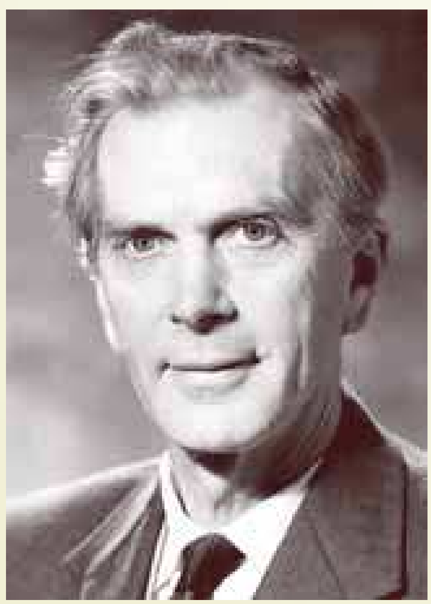
"Ryle quickly appreciated that the distribution of radio sources throughout the universe had cosmological implications and that the number of sources found tended to support the evolutionary big bang theory rather than the steady-state theory."
A Dictionary of Scientists, Oxford University Press, 1999

"Ryle was a key figure in the development of radio astronomy after the Second World War, following the pioneering discoveries of Jansky and Reber."
The Cambridge Dictionary of Scientists, 2002

Martin Ryle is considered as one of the great astronomers of the 20th century. He developed revolutionary radio telescope system for locating weak radio sources. Ryle observed the most distant known galaxies of the universe of his time. He received the Nobel Prize for Physics in 1974, jointly with Antony Hewish. They were given the Prize "for their pioneering research in astrophysics: Ryle for his observations and inventions, in particular of the aperture synthesis technique, and Hewish for his decisive role in the discovery of pulsars." This was first Nobel Prize given in recognition of astronomical research.

Under Ryle's guidance the radio astronomy group of the Cavendish Laboratory developed the radio source catalogues, known as the *Cambridge Catalogues*. The *Third Cambridge Catalogue*, which was produced in 1959, led to the discovery of the first quasi-stellar object or quasar. Ryle's results, which showed that the distant parts of the universe appeared different from the nearer parts, supported the Big Bang theory of the origin of the universe rather than a steady state theory.

In 1948 Ryle was appointed to a Lectureship in Physics and in 1949 he was elected to a Fellowship at Trinity College of Cambridge University. In 1959 Cambridge University created its first Chair of Radio Astronomy and Ryle became its first incumbent. Ryle founded the Mullard Radio Astronomy Observatory in 1957 and he was its first Director. In 1959 Ryle became the first professor of Radio Astronomy at the University of Cambridge. He succeeded Richard Woolley as Astronomer Royal (1972 -82).


Martin Ryle

Ryle was born on 27 September 1918 at Brighton, England. His father John A. Ryle was a doctor who was appointed to the first Chair of Social Medicine at Oxford University. Ryle was the nephew of the well-known British philosopher Gilbert Ryle (1900-1976).

In 1939, Ryle graduated from the University of Oxford in physics and then he worked with the Telecommunications Research Establishment on the design of radar equipment during the Second World War. After the War he got a Fellowship for working at the Cavendish Laboratory of Cambridge University. In getting the fellowship at Cambridge he was helped by the influential British Radio physicist John Ashworth Ratcliffe (1902-1987). Ryle had earlier worked with Ratcliffe during the War. At Cambridge, Ryle became an early investigator of extraterrestrial radio sources. He developed an advanced radio telescope. During his early period at the Cavendish Laboratory, Ryle was encouraged by Ratcliffe and William Lawrence Bragg. Ryle wrote: "During these early months, and for many years afterwards both Ratcliffe and Sir Lawrence Bragg, then Cavendish Professor, gave enormous support and encouragement to me. Bragg's own work on X-ray crystallography involved techniques very similar to those we were developing for 'aperture synthesis', and he always showed a delighted interest in the way our work progressed." Ryle's early work at the Cavendish Laboratory centred on studies of radio waves emitted by the Sun, sunspots, and a few nearby stars. Ryle realised the need of developing better observing techniques for better observation of the radio sources. Under his leadership the Cambridge group took up this challenge and created and improved the astronomical interferometry and aperture synthesis technique.

Radio astronomy is a branch of astronomy that studies celestial objects at radio frequencies. Before the emergence of radio astronomy, astronomers knew only about objects in the universe that shone in visible light. Radio astronomy opened up many parts of the universe that were invisible to astronomers till then. There is a wide radio window covering wavelengths from about 1 mm to 30 m, almost all of it accessible from ground-based observatories, both day and night. Radio window is the region of the electromagnetic spectrum in the radio frequency band within which radio waves can pass through the Earth's atmosphere without significant amount of reflection or attenuation by the constituents of the atmosphere. Radio signals from space are detected and measured by instruments called radio telescopes.

Grote Reber

The advances in radio astronomy led to many important discoveries including radio galaxies, quasar, pulsars, maser sources, and the cosmic microwave background radiation. A radio galaxy is a radio source outside the Milky Way that has been previously identified with an optical visible galaxy. A radio galaxy is an unusually powerful emitter of radio waves with output of the order of up to 10^{38} watts – a million times greater than a normal galaxy such as the Milky Way. It is believed that the radio source of a radio galaxy is powered by super-massive black hole located in the nucleus of the galaxy. A quasar is an object with a high redshift which looks like a star, but is probably the very luminous active nucleus of a distant galaxy. The name is a contraction of 'quasi star', from their star-like appearance. Quasars were discovered by Allan Sandage and Maarten Schmidt. Pulsars are rapidly spinning neutron stars having a diameter of 20-30 km. A pulsar is a radio source from which highly regular train of pulses are received on Earth. Pulsars were discovered by Anthony Hewish and Jocelyn Bell. A maser source in space is a radio source in which the spectral lines of an atom, ion, or molecule are greatly amplified by maser action to produce an intense source of radio emission. It may be noted that in maser, radiation at a certain frequency causes excited atoms, ions or molecules of a gas to emit further radiation in the same direction and the same wavelength, resulting in amplification.

The idea that dark matter is an important component of the universe has been substantiated by the findings of radio astronomy. Radio measurements of the rotation of galaxies have indicated there should be much more mass in galaxies than what has been actually observed.

The fact that celestial objects may be emitting radio waves was anticipated before its actual discovery. James Clerk Maxwell's equations developed in the 1860s had indicated that electromagnetic radiation from stellar sources could exist with any wavelength and not just in optical wavelengths. Noted scientists and experimentalists like Nikola Tesla, Oliver Lodge and Max Planck had predicted that the Sun should be emitting radio waves. In fact, Lodge had attempted to observe radio signals emitted by the Sun but he failed to detect them due to technical limitations of his apparatus.

It was American Radio engineer Karl Guthe Jansky (1905-1950), who discovered the first astronomical radio source. It was an example of chance discovery. Jansky, an engineer with Bell Telephone Laboratories, was investigating static that interfered with short-wave transatlantic voice transmission by using a large directional antenna. During his investigation Jansky found that his analog pen-and-paper recording system was continuing recording a repeating signal, the origin of which was not known. Jansky's original assumption was that the Sun might be the source of the interference. His assumption was based on the fact that the signal peaked once a day. However, detailed continuous analysis revealed that the source of the signal was not following the 24-hour cycle for the rising and setting the Sun. Instead it was repeating on a cycle of 23 hours and 56 minutes, a cycle typical of an astronomical source 'fixed' on the celestial sphere rotating in synchronous with sidereal time. After comparing his observations with astronomical maps Jansky reached the conclusion that the source of the radiation was located in the Milky Way. He also observed that the radiation was the strongest in the direction of the centre of the Galaxy or the Sagittarius constellation. Jansky's discovery was announced in 1933. Jansky wanted to investigate further but he had to abandon his plan as he was asked by the Bell Laboratories to work on another project.

In 1937, American amateur astronomer Grote Reber (1911-) built a large paraboloidal "dish" radio telescope with a diameter of 9.4 metres. The telescope was movable in declination like a transit instrument; that is, a telescope constrained to rotate in the plane of the meridian about a horizontal axis mounted east-west. Reber conducted the first sky survey in the radio frequencies. He detected many radio sources or radio stars including Cassiopeia A and Cygnus A that did not correspond to visible stars. He also found that the Sun and the Andromeda Galaxy emit radiation at radio wavelengths. From the time he built his radio telescope till the end of the Second World War, Reber was the only radio astronomer in the world. Like Jansky, he was a pioneer in radio astronomy. Another early radio astronomer was J. S. Hey, a British Army research officer, who made a discovery that the Sun emitted radio waves.

It was Martin Ryle who brought a revolution in radio astronomy. After the end of the Second World War, Ryle began to establish a centre for radio astronomy at the Cavendish Laboratory, Cambridge. He opted for radio interferometers rather than parabolic receivers employed earlier. It was the difficulty in achieving high resolutions with single radio telescopes that led Ryle and Australian-born engineer, radio physicist, and radio astronomer Lade Pawsey to develop radio interferometry. A radio interferometer consists of widely spaced radio telescopes that are connected together for observing the same object at the same time. Using radio interferometry Ryle developed the technique of aperture synthesis, a technique used in radio astronomy to achieve vast increase in

William Lawrence Bragg

Nikola Tesla

angular resolution. The technique uses an array of telescopes to simulate a single telescope of large aperture. To achieve a high-quality image a large number different separations between different telescopes called baselines are required. Aperture synthesis requires complex data-reduction techniques and powerful computers. Examples of aperture telescopes are MERLIN, the Ryle Telescope, the Very Large Array, and the Westerbork Synthesis Radio Telescope. Ryle used 12 telescopes to develop the first radio interferometer. The Very Large Array has 27 telescopes giving 351 independent baselines at once.

Ryle and his group conducted surveys of radio-emitting sources in the universe. These surveys called cosmological surveys mapped the radio sources. The results of the surveys were published in the form of catalogues known as *Cambridge Calalogues.* The first cosmological survey was completed in 1950 and it identified 50 radio sources. The second survey completed in 1955 identified about 200 radio sources. The third survey was the most crucial. The results of the third survey were published in 1959 in the *Third Cambridge Catalogue* (3C). It listed the positions and strengths of 500 radio sources. It has become the definitive catalogue used by all astronomers. The third survey led to the discovery of the first quasi-stellar object. Ryle and his group identified a radio source 500 million light years away from the Solar System. This object was located in the Cygnus constellation. This discovery underlined the importance of radio telescopes. The identification of an object at such great distance mean that one can see very far back into the history of the universe, and which in turn can help reveal information on the origin of the universe. The fourth survey, which was completed in 1965, detected radio sources five times fainter than those in the third survey. This was made possible by use of more sensitive receivers. The fourth survey covered whole of the northern sky and it catalogued 5,000 sources. Further in-depth surveys of the sky were undertaken with the opening of two highly sensitive radio telescopes in 1965 and 1971.

Ryle was not an easy person to work with. He had a hot temper. Most of the time he used to work in an office at the Mullard Radio Astronomy Observatory so that he did not get entangled in heated arguments with other members of the Cavendish Laboratory. He had a famous heated argument with Fred Hoyle on the latter's Steady State Theory. This debate is believed to have reduced collaboration between Hoyle's Institute of Astronomy and Ryle's Radio Astronomy Group at the Cavendish Laboratory.

Ryle believed that the only way to save our planet from complete nuclear annihilation was to put indefinite ban on use of any kind of nuclear device. He wrote on the politic of nuclear disarmament or the so-called nuclear proliferation. In his book, *Towards the Nuclear Holocaust* (1981), Ryle expressed his concerns about nuclear arms race and the misuse of science. He was great advocate of renewable sources of energy. He championed the cause of wind power in England.

In recognition of his work Ryle received numerous awards and honours. He was elected a Fellow of the Royal Society of London in 1952. He was the President of Commission 40 of the International Astronomical Union (1964-1967). Among his other awards included Hughes Medal of the Royal Society of London (1954); Gold Medal of the Royal Astronomical Society of London (1964); Henry Draper Medal of the US National Academy of Sciences (1965); Royal Medal of the Royal Society of London (1973); Bruce Medal of the Astronomical Society of the Pacific (1974). In 1966, the British Government Knighted Ryle for his achievements in radio astronomy.

Ryle died on 14 October 1984 in Cambridge after fighting a long battle with lung cancer.

Karl Guthe Jansky

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(The article is a popular presentation of the important points on the life and work of Martin Ryle available in the existing literature. The idea is to inspire the younger generation to know about Martin Ryle. The author has given the sources consulted for writing this article. However, the sources on the Internet are numerous and so they have not been individually listed. The author is grateful to all those authors whose works have contributed to writing this article.)

Food and Drug Interactions during medication

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Often food-drug interaction is overlooked resulting in unforeseen complications. These commonly occur during multiple medications for chronic medical conditions. Physiological changes affect drug absorption, distribution, metabolism and excretion as well as its action. This variability in drug action may be further enhanced by interaction with foods. Individuals on multiple medications are usually prone to these effects. In addition, endocrine dysfunction, restrictive diets and alcoholism in many patients may further complicate these interactions.

Many people have the mistaken notion that medicines when consumed with foods are safe. But it is not so. Very often, medicines may interact with food we normally take, resulting in serious side effects. New medicines and new drug delivery systems have made drug administration simpler. However, still they are known to cause unforeseen side effects with certain foods. Therefore, both prescription and over-the-counter drugs need to be taken with caution.

Drug absorption and bioavailability

Food can decrease, increase or delay the absorption of certain drugs by changing the body's ability to absorb the drug. Food affects the bioavailability of certain medications by inhibiting certain intestinal enzymes such as CYP3A4 as well as P-glycoprotein and organic anion transporting polypeptide transporters. A medication has ingredients, just as food does, that allow it to function correctly when taken to treat a disease condition. Food can interfere with the effectiveness of a drug if it interacts with the ingredients in it. Nutrients in food may either delay absorption into the body, speed up elimination from the body, or can impact a drug's effectiveness. For example, the acidic ingredients in fruit juices are capable of decreasing the power of antibiotics, such as penicillin. Similarly, the effect of tetracycline is impaired by the consumption of dairy products. Grapefruit juice may react with several medications, leading to an increase in systemic exposure. Apart from this, anti-depressants can also be dangerous if taken with beverages or foods that contain tyramine, which is found in items such as beer, red wine, and some cheeses.

Drugs and nutrients in our food can sometimes bind together to form compounds that the body cannot absorb. When this occurs, neither the drug nor the nutrient is of any use to the individual. The presence of food in the stomach can also increase the absorption of fat-soluble drugs. High carbohydrate meals decrease gastric emptying time, leading to increased absorption of hydroenterothiazide drugs (e.g., Esidtex, etc.)

Aging is one of the factors often associated with slowing of gastric emptying, diminished gut wall function, and an increase in gastric pH. Drugs with anticholinergic properties (e.g., traditional antihistamines: diphenoxylate HCl with atropine sulphate) slow gastric emptying and can delay drug absorption and onset of action. Antacids, H2 blockers and proton pump inhibitors also alter gastric pH, which affects the rate of dissolution of many drugs. Milk and milk products can raise the gastric pH and cause enteric-coated tablets to dissolve prematurely. This can result in altered drug absorption as well as gastric irritation. In older people, where congestive heart failure or urinary incontinence frequently requires fluid restriction, drugs may be taken with too little fluid resulting in the delayed dissolution and absorption.

Food can also alter transport mechanisms important in the drug absorption process. Milk and other products containing calcium can form a complex with some drugs, such as fluoroquinolones (ciprofloxacin, nofloxacin and others) impairing their absorption. In addition, nutrients can affect intestinal transit time, visceral and hepatic blood flow, and can act as a physical barrier by hindering drug (tablet, capsule) dissolution, or preventing the drug from getting to the mucosal surface of the gastrointestinal tract. Older patients are supposed to take these drugs only with water and limit taking dairy products within one or two hours of taking these drugs. Dietary fibre can impair the absorption of penicillin.

Occasionally, almost any ingested food or liquid can alter absorption of certain medications, the most important example of which are the bisphosphonates used for management of osteoporosis. Bisphosphonate absorption is prevented by intake of food, orange juice, coffee, calcium products and other medications. But its absorption remains unaffected by water.

Drug metabolism

In general, the composition of one's diet can affect how a drug is metabolised and processed in the body. Diets high in carbohydrate but low in protein can increase the metabolism of certain drugs such as theophylline, while a low-carbohydrate high-protein diet will increase the length of time it takes to achieve therapeutic levels of most drugs by increasing the levels of metabolising enzymes.

The quantity and quality of food is also influential. High-protein, low-carbohydrate diets can accelerate the hepatic metabolism of several drugs; alcohol can have similar effects. A high-fat diet can compete with the binding sites on albumin and alter serum drug concentrations and distribution. This may be an issue for patients eating out (fast foods in particular) or consuming high quantities of processed foods.

Mechanism of food-drug interactions

Food-drug interactions can be either pharmacodynamic (relating to action of drug) or pharmacokinetic (relating to the drug's absorption, distribution, metabolism and excretion). Both of these pharmacologic properties can be enhanced or antagonised by food. For example, vegetables high in vitamin K (e.g., asparagus, red leaf lettuce) pharmacodynamically antagonise the anticoagulation effects of warfarin, making it essential to counsel patients on vitamin K treatment to limit intake of vitamin K. Increased dietary sodium can negate the effectiveness of many antihypertensive agents such as thiazides and can alter the renal excretion of lithium. Pyridoxine (vitamin B6) intake should be avoided while on the Lewdopa, used for treatment of Parkinson's, since pyridoxine helps to transform the drug into dopamine, which cannot cross the blood-brain barrier.

Elimination of drugs

Drugs are eliminated from the body either unchanged or as metabolites. Kidneys are involved in elimination of majority of a drug and its metabolites from the body. The renal function is altered by electrolyte disturbances or other factors that influence glomerular filtration and tubular reabsorption. For example, consumption of large amounts of acidic fruit juices (orange, tomato and grape juice) increases urinary pH, which can cause some drugs such as amphetamine and quindine to be reabsorbed into the body, which can potentially lead to drug toxicity.

Drug–alcohol incompatibility

The use of alcohol with drugs can result in clinically significant interactions. Interactions are more common in alcoholics than in persons who consume small amounts of alcohol.

Drug metabolism is affected by both acute and chronic use of alcohol. Chronic use results in increased metabolism and the need for increased doses of anticonvulsants, sedatives, and the anti-TB drug isoniazid. Acute use of alcohol leads to decreased metabolism of drugs metabolised by hepatic enzymes.

Consumption of large amounts of alcohol over a short time by habitual drinkers, or of small amounts by individual who seldom drinks can have synergistic effect with central nervous system depressants and can cause complications. The use of alcohol with corticosteroids, aspirin or non-steroidal anti-inflammatory drugs can produce excessive gastrointestinal bleeding or gastritis, especially when these drugs are taken on an empty stomach. Alcohol produces generalised expansion of blood vessels; so, patients taking nitroglycerin should not drink alcohol within 30 minutes of its administration.

Individuals receiving oral glucose-reducing drugs (medicines for type-2 diabetes; not insulin therapy) may need to avoid alcohol because acute alcohol ingestion can alter carbohydrate metabolism, leading to hypoglycaemia (lowering of blood glucose level).

Herbs, food, and drug interactions

As new herbs are used for medication, there is more potential for the abuse of these herbs and the patients may end up with serious problems. High-risk patients, such as elderly, patients taking three or more medications for chronic conditions, and patients suffering from diabetes, hypertension, depression, high cholesterol or congestive heart failure, should be especially on the lookout for reactions.

The following are the examples of known interaction between popular herbs, foods, and prescription and over-the-counter drugs.

Hawthorn, touted as effective in reducing angina attacks by lowering blood pressure and cholesterol levels, should never be taken with Lanoxin (digoxin), the medication prescribed for most for heart ailments. The mix can lower the heart rate drastically, causing blood to pool, bringing on possible heart failure.

Ginseng can increase blood pressure, making it dangerous for those trying to keep their blood pressure under control. Ginseng, garlic or supplements containing ginger, when taken with the blood-thinning drug (Coumadin), can cause bleeding episodes. Coumadin is a very powerful drug that leaves little room for error, and patients taking it should never take any medication or otherwise before consulting a qualified health professional. In rare cases, ginseng may over stimulate resulting in insomnia. Consuming caffeine with ginseng increases the risk of over stimulation and gastrointestinal upset. Long-term use of ginseng may cause menstrual abnormalities and breast tenderness in some women. Ginseng is not recommended for pregnant or lactating women.

Garlic capsules combined with diabetes medication can cause a dangerous decrease in blood sugars. Some people who are sensitive to garlic may experience heartburn and flatulence. Garlic has anti-coagulating properties.

Raspberries contain a natural salicylate that can cause an allergic reaction in aspirin sensitive people.

Table-1 Common food-drug interactions and their effects	
Drugs	**Effects and precautions**
Antibiotics	
Cephalosporins, penicillin	To be taken on an empty stomach to speed up absorption of the drugs.
Erythromycin	Not to be taken with fruit juice or wine, which decreases the drug's effectiveness.
Sulpha drugs	Increase the risk of vitamin B12 deficiency
Tetracycline	Not to be taken with dairy products, which reduce the drug's effectiveness. Lowers vitamin C absorption
Anticonvulsants	
Dilantin, phenobarbital	Increases the risk of anaemia and nerve problems due to deficiency of folate and other B vitamins.
Antidepressants	
Fluoxetine	Reduces appetite and can lead to excessive weight loss
Lithium	A low-salt diet increases the risk of lithium toxicity; excessive salt reduces the drug's efficacy
MAO Inhibitors	Foods high in tyramine (aged cheeses, processed meats, legumes, wine, beer, among others) can bring on a hypertensive crisis.
Tricyclics	Many foods, especially legumes, meat, fish, and foods high in Vitamin C, reduce absorption of the drug.
Antihypertensives, heart medications	
ACE inhibitors	To be taken on an empty stomach to improve the absorption of the drug.
Alpha blockers	To be taken with liquid or food to avoid excessive drop in blood pressure.
Antiarrhythmic drugs	Caffeine to be avoided, as it increases the risk of irregular heartbeat.
Beta blockers	To be taken on an empty stomach; food, especially meat, increases the drug's effects and can cause dizziness and low blood pressure.
Digitalis	Not to be taken with milk and high-fibre foods, which reduce absorption and increases potassium loss.
Diuretics	
Potassium sparing diuretics	Unless a doctor advises otherwise, diuretics with potassium supplements or salt substitutes not to be taken because it can cause potassium overload.
Asthma drugs	
Pseudoephedrine	Caffeine to be avoided because it increases feelings of anxiety and nervousness.
Theophylline	Foods cooked over charcoal fire and high-protein diet reduce absorption. Caffeine increases the risk of drug toxicity.
Cholesterol lowering drugs	
Cholestyramine	Increases the excretion of folate and vitamins A, D, E, and K.
Gemfibrozil	Fatty foods to be avoided, as they decrease the drug's efficacy in lowering cholesterol.

(Contd. on next page)

Drugs	Effects and precautions
Heartburn and ulcer medications	
Antacids	Interfere with the absorption of many minerals; for maximum benefit, medication to be taken one hour after eating.
Cimetidine, Fanotidine, Sucralfate	High-protein foods, caffeine, and other items that increase stomach acidity to be avoided.
Hormone preparations	
Oral contraceptives	Salty foods increase fluid retention. Drugs reduce the absorption of folate, vitamin B6, and other nutrients; intake of foods high in these nutrients to be increased to avoid deficiencies.
Steroids	Salty foods increase fluid retention. Intake of foods high in calcium, vitamin K, potassium, and protein to be increased to avoid deficiencies.
Thyroid drugs	Iodine-rich foods lower the drug's efficacy.
Laxatives	
Mineral oils	Overuse can cause a deficiency of vitamins A, D, E, and K.
Painkillers	
Aspirin and stronger non-steroidal anti-inflammatory drugs	Always to be taken with food to lower the risk of gastrointestinal irritation; not to be taken with alcohol, which increases the risk of bleeding. Frequent use of these drugs lowers the absorption of folate and vitamin C.
Codeine	Fibre and water intake to be increased to avoid constipation.
Sleeping pills, tranquilizers	
Benzodiazepines	Never to be taken with alcohol. Caffeine increases anxiety and reduce drug's effectiveness.

Grilled meat can lead to problems for those on asthma medications containing theophyllines. The chemical compounds formed when meat is grilled somehow prevent this type of medication from working effectively, increasing the possibility of an unmanageable asthma attack.

High fat in diet with anti-inflammatory and arthritis medications can cause kidney damage and can leave the patient feeling, drowsy and sedated.

Aspirin can modify the effectiveness of arthritis medications, strong prescription steroids and diuretics. Combining aspirin with diabetic medications can lower blood sugars to dangerous levels. Aspirin can also cause toxicity when taken with glaucoma and anticonvulsant (anti-seizure) drugs and cause bleeding episodes when combined with a blood thinner, like Coumadin.

Antacids when taken with antibiotics and medications for heart ailments, blood pressure or thyroid problems can decrease drug absorption by 90%.

Oral contraceptives are less effective when taken with barbiturates, antibiotics, anti-fungal or tuberculosis drugs.

High-risk population

The elderly population is at a higher risk as far as food-drug interactions are concerned, as this population often takes the highest amount of medications. With so many medications, daily problems are bound to exist. Elderly people, who take many drugs on a routine basis for long periods of time, are at the greatest risk of nutrient depletion and nutritional deficiencies.

Drug-drug or drug-food interaction can be overcome by involving more health care and nutritional professionals for counselling. They can prevent significant drug therapy related morbidity by carefully monitoring and selecting drugs for individuals and by educating them about interaction of drugs they take with the food they eat.

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The Infernal Intoxication Alcoholism

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Hail! O drinkers of *Saki*—
First the man takes a drink
Then the drink takes a drink
Next the drink takes the man
-A Japanese Ode to Alcoholics

Even though alcohol has been man's favourite mood-altering substance for thousands of years and was used as a medication in the olden times, throughout most of history, society has viewed people who drink to excess as irresponsible, immoral, and weak in character. Strict prohibition laws were imposed and punishment of drunkenness was considered necessary to protect the community. Yet, alcoholism is on the rise in most countries. The World Health Organization estimates that over 62 million people worldwide suffer from alcohol dependence. In this first part of a trilogy on alcoholism, we trace the history of alcohol, its metabolism within the body and also its intoxicating dose.

To all those who enjoy being on cloud nine with a glass of alcohol in their insides, it may come as a heady concoction to know that the early man had ventured into agriculture primarily to secure a dependable supply of beer! Well, that's a hypothesis put forth by the US anthropologist Solomon Katz. If this beer-seeking agrarian hypothesis is any good, and you do not mind extending it a little further, you could say, alcohol is the mother of human civilization. Had the neolithic man not taken to tillage for the tipple, *Homo sapiens* would still be nomads.

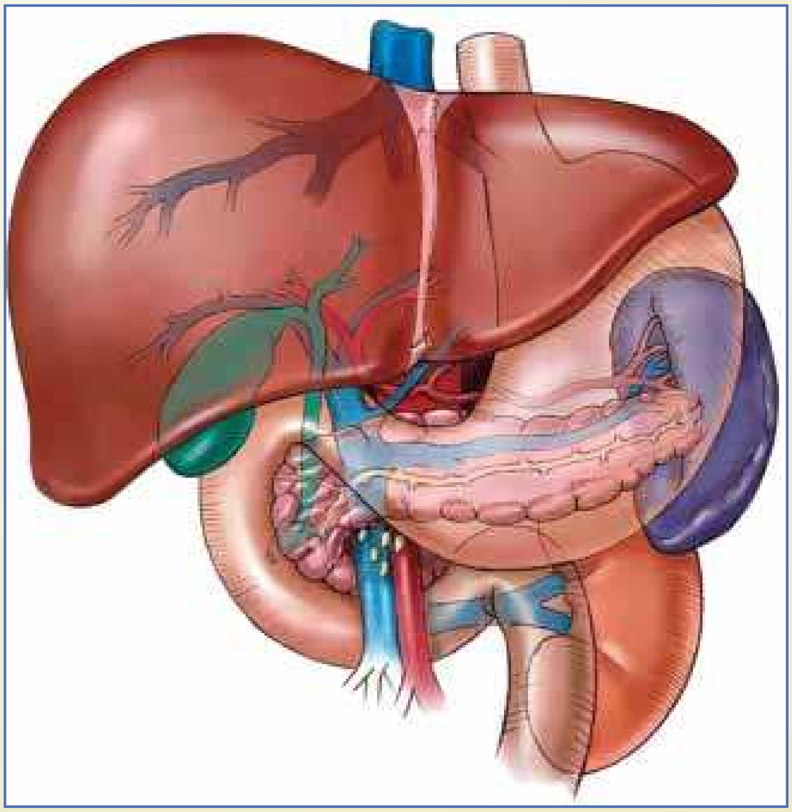
The story of alcohol

Whether Katz's premise is correct or not, alcohol has been around, wetting the human throat, even before the dawn of civilization. Ethanol—call it beer, whiskey, gin, or rum—and carbon dioxide are the natural excreta of yeasts that consume, and ferment, sugar. While yeasts—the microscopic unicellular fungi—have inhabited Earth since before the time of Noah, sugar is abundant in fruits, grains, sap, nectar, and other plant life.

Man and, before him, other animals have enjoyed ethanol produced in nature from fermented saps and fruits. But when man decided to settle into herds, and communities and civilization arose, he also devised reliable ways of brewing and distilling alcohol. Several texts originating in Vedic India, including the *Rig Veda*, *Yajur Veda* and *Atharva Veda*, state the useful properties of alcohol the *Soma Rasa*, a life sustaining substance. In *Rig Veda*, which dates back to between 4,000 and 6,000 BC, alcohol is listed among 67 medicinal products. In ancient Middle East, in the fertile lands bathed by the Nile and Euphrates rivers, the Egyptians and the Babylonians had found out that if they crushed grapes, or warmed and moistened the grain, the covered mush would bubble up to yield a drink with a kick. The process of malting—as it is now called—would permit the grain to sprout just enough to release enzymes that convert starches into simple sugar, which yeasts devour voraciously. The yeasts ferment the sugar, till it runs out. Once this happens, the yeasts simply whither away, and the production of alcohol stops. This simple technique is still used in home brewing of alcohol. The alcohol concentration in this mix cannot top 14 per cent. A stronger drink requires distillation. Breweries and distilleries owe their popularity to this fact.

The origins of alcohol distillation are rather obscure. Probably, the first distillation of alcohol was performed at a medical school in Salerno, Italy, during the Middle Ages. Wine was boiled and the vapours cooled and condensed to produce a more powerful medicine. A Spanish scholar gave this ragged brandy the name aqua vitae, the water of life.

Soon, the 'water of life' began to take many forms. It passed through charred barrels, peat smoke, and the holy hymns of monasteries in 11th-century England to evolve as *usquebaugh,* shortened later to *whiskey,* distilled in Russia as *vodka*, in



Holland as juniper-flavoured *jenever* (the British shortened it to *gin*), and at a medical school in Monpellier, France, in 1300 AD into *brandy*.

The making of the word 'alcohol' is no less interesting. Those who are familiar with the basics of origin and historical development of linguistic forms may easily guess that the *al-* in alcohol is a word of Arabic descent, as is the case with algebra and alkali. In fact, al- is the Arabic definite article; it corresponds to 'the' in English. The origin of -cohol relates to *kuhl*, a fine antimony powder used by women to darken and beautify their eyelids. It was thus that the Arabic chemists came to use *al-kuhl* for any fine powder. Later the usage of the word was extended to include any exotic essence obtained by distillation. Medieval Latin picked it from Arabic, and the English revised it to alcohol giving it the modern connotation.

Be as it may, alcohol, the magic potion, found a home and came to be extensively used all over the world. Over time, its dark effects also came to be known and seeing people reel under its vile dominance, lawmakers were forced to enact prohibition laws.

Still, all alcohol is not bad. If taken in small amount, between 30 and 60 ml a day, it may help lower the risk of coronary heart disease. This good effect may be related to the scientific finding that alcohol increases the level of HDL (high density lipoproteins, or good cholesterol) in blood, which protects the heart by arresting the progress of atherosclerosis, the piling up of fat in the arteries. That it, in addition, gladdens the heart and drowns the miseries of life is a bonus.

What happens to alcohol in the body

Though many factors—such as age, sex, weight, genes, and drinking history—come into play, all healthy bodies process alcohol in much the same way. As you sip alcohol, it races through the mouth and the food pipe to quickly slide into the stomach. This is its first halt or stopover. Some of it gets absorbed here, but a larger amount slips into small intestine, from where it is hauled into the bloodstream. With its natural affinity for water, the bloodstream becomes a natural vehicle and takes it everywhere in the body.

Even as alcohol races through the body affecting several vital organs all at once, the human body takes active steps to dispose of it. Several body mechanisms are put on alert. Breath, sweat and urine directly expel two to ten per cent alcohol. The major responsibility of getting rid of alcohol however rests upon the largest chemical factory in our body, the liver. Enzymes in the liver set off to pulverize it. The liver first transforms alcohol into acetaldehyde, then to acetate, and finally into carbon dioxide and water. The process is slow, and runs at a rate of 10 millilitres of pure alcohol every hour.

A number of factors can influence the absorption and blood concentration of alcohol. The total dose, the strength of the solution, the time over which its is taken, the presence or absence of food in the stomach, the time relation of taking food and alcohol and the kind of food eaten, all influence this process.

If a person has an empty stomach, alcohol is quick to pass into the small intestine and is more quickly absorbed. The quicker a person empties the glass, the quicker is the build up. Likewise, blood concentration also relates to the content of alcohol in a drink. For example, 340 ml of beer, 115 ml of wine, and a shot (43ml) of whiskey, rum or gin each contain approximately 10 g of alcohol. The presence of food especially milk, fat and

carbohydrates dampens absorption, but the absorption becomes quicker if alcohol is diluted up to one in five parts water, or has been carbonated (champagne, whiskey and soda).

The blood concentration is also, like any other drug, related to the person's weight. A person lighter in weight hits a high with a smaller dose of alcohol as compared to a heavier person. A woman tends to feel the effect of alcohol more quickly than a man of the same weight, because she has a greater proportion of body fat than man.

Genes can come into play as well. Some people, particularly Asians, carry an altered gene that makes drinking unpleasant. This gene inactivates the enzyme that breaks down acetaldehyde, prolongs the build up of this toxic chemical, and leads to flushed face and sweaty and sick countenance.

The intoxicating dose

The behavioural and physiologic effects of any drug depend upon the dose, its rate of increase in the blood, the simultaneous presence of any other drug, and the past experience with the agent.

Even though 'legal intoxication' requires a blood alcohol concentration of at least 80 to 100 mg/dl, changes in behaviour, psychomotor and cognitive functions are seen as even the first or the second drink hits the stomach. At twice the legal intoxication level many people slip into a deep sleep or narcosis; and death can occur once blood alcohol levels cross the 300mg/dl mark. At this stage, the inebriate may slip into coma and die from respiratory failure. ■

Recent Developments in Science and Technology

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Supermassive black hole at the centre of the Milky Way

There is a supermassive black hole at the centre of our Milky Way galaxy. A team of American astrophysicists led by Andrea Ghez of the University of California, Los Angeles have measured the mass of the Milky Way's central black hole. The team's measurement yields a mass of 4.5 ± 0.4 million Suns, as reported in the advance online edition of *Astrophysical Journal* (arXiv:0808.2870v1[astro-ph] 21 August 2008). The diameter of the event horizon of a black hole of that mass would be about 0.1 astronomical unit (about 15 million kilometres).

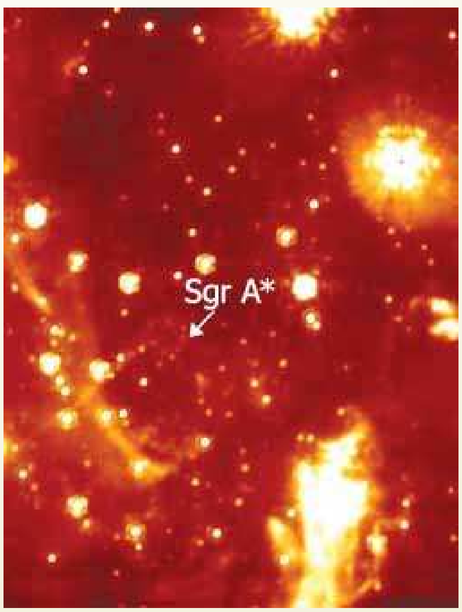


Image of the centre of the Milky Way galaxy, taken with Keck telescope at an infrared wavelength of 3.8 microns, shows many stars around the position of the central supermassive black hole (Sgr A).*
Credit: UCLA Galactic Center Group/Keck Observatory

The significance of the new measurement lies in the fact that the centre of the Milky Way is situated more than 27,000 light-years away, and is not visible from Earth. It is hidden behind thick clouds of gas and dust along our line of sight. Ghez and her team employed all the resources of modern astronomy including a really big telescope, detectors that operate in the infrared, and the relatively recent technology of adaptive optics. Using the 10-metre Keck I and II telescopes in Hawaii, the team has been observing the galactic centre for the past decade at infrared wavelengths, which can penetrate the thick clouds of gas and dust. The use of adaptive optics made it possible for them to improve the performance of optical systems by reducing the effects of rapidly changing optical distortion caused by Earth's turbulent atmosphere. (It is commonly used on astronomical telescopes to remove the effects of atmospheric distortion.) The combination of these techniques allowed the group to resolve dozens of individual stars near the galactic centre and study their orbital motions.

The high mass of the Milky Way's black hole, known as Sagittarius A* (Sgr A*), made anything orbiting near to move really, really fast. The stars around the black hole were found to be whirling around the black hole at speeds exceeding 4,500 km per second (16 million kilometres per hour). By using Newton's laws, Ghez could use these stellar velocities to derive the mass of the central object.

Besides coming up with a more precise mass measurement, the latest observations also refine the distance to the Milky Way's centre to 27,400 light-years, with an uncertainty of 1,300 light-years.

Snow found in Martian skies

NASA's *Phoenix Mars Lander*, which has been taking measurements at the Martian north pole since 25 May 2008, has detected snow falling from Martian clouds, and spacecraft soil tests have given evidence of past interaction between minerals and liquid water – processes seen on Earth. The discovery of snow in Martian sky was made by an instrument that shined a laser into clouds about four kilometres above the ground, revealing the presence of ice crystals. However, the *Phoenix* data show the snow vaporising before reaching the ground. Even before *Phoenix* landed, scientists knew water-ice, along with ice made of carbon dioxide, accumulated on the ground in the northern latitudes during the harsh Martian winter, when temperatures plunge to minus 120 degrees Celsius. But the discovery of snow in the atmosphere above the pole came as a surprise.

According to NASA and JPL scientists, the *Phoenix* experiments also yielded clues pointing to calcium carbonate, the main component of chalk, and particles that could be clay. The evidence for calcium carbonate in soil samples from trenches dug by the *Phoenix* robotic arm comes from two instruments called the 'Thermal and Evolved Gas Analyser' and the wet chemistry laboratory of the 'Microscopy, Electrochemistry and Conductivity Analyser'. Most carbonates and clays on Earth form only in the presence of liquid water; so presence of these substances on Mars points toward episodes of interaction with water in the past.

Phoenix has already confirmed that a hard subsurface layer at its far-northern landing site contains water-ice. Determining whether that ice ever thaws would help answer whether the environment there has been favourable for life, a key aim of the mission.

Accumulation of water-ice, along with ice made of carbon dioxide on the ground in the northern latitudes during the harsh Martian winter has been known, but the discovery of snow in the atmosphere above the pole came as a surprise.

When *Phoenix* landed in May, it was late spring on Mars. The Sun remained up almost all day, allowing *Phoenix*'s solar panels to collect plenty of energy to run its various instruments, which include a robotic digging arm and two chemistry labs. Now, with winter approaching, the Sun is below the horizon about four hours of each Martian day, which is about 24 hours, 40 minutes long. As temperatures drop further, *Phoenix* must use more and more energy to operate the heaters that keep the instruments warm. According to NASA scientists, before the end of October, there would not be enough energy to keep using the robotic arm. Before power ceases, the *Phoenix* team plans to try to activate a microphone on the lander to possibly capture sounds on Mars.

Record rise in atmospheric CO_2 level

There is bad news for environmentalists. Atmospheric carbon dioxide (CO_2) concentrations have grown four times faster than in previous decade, according to the latest figures released by the Global Carbon Project (GCP) on 26 September 2008. Between 2006 and 2007, carbon dioxide output rose by 3%, far exceeding the amount projected by a Nobel Prize-winning group of international scientists in 2007. Annual mean growth rate of atmospheric CO_2 was 2.2 parts per million (ppm) per year in 2007 (up from 1.8 ppm in 2006), and above the 2.0 ppm average for the period 2000-2007. The average annual mean growth rate for the previous 20 years was about 1.5 ppm per year.

This clearly indicates that efforts to curb carbon emissions under the Kyoto Protocol have not done enough to stop emissions increasing in industrialised nations and the developing world alike. The new data also shows that forests and oceans, which take up much of the carbon dioxide humans emit, are having less impact. These "natural sinks" have absorbed 54% of carbon dioxide emissions released since 2000, a drop of 3 percentage points compared with the period between 1959 and 2000. If these trends continue, the world will be on track for the highest predicted rises in temperature and sea level.

According to the GCP report, the highest emitter was China, followed by the United States, which past data show is the leader in emissions per person in carbon dioxide output. China's added emissions accounted for more than half of the worldwide increase; it emitted 2 billion tons of carbon last year, 7.5% more than in the previous year. Although several developed countries slightly reduced output in 2007, the US churned out more. Denmark's emissions dropped 8%. The United Kingdom and Germany reduced carbon dioxide emission by 3%, while France and Australia cut it by 2%.

Developing countries, which were not asked to reduce greenhouse gases by the 1997 Kyoto treaty – China and India are among them – now account for 53% of carbon dioxide emission. According to the report, India is in position to beat Russia for the No. 3 carbon dioxide emitter behind the US, and Indonesia's levels are increasing rapidly.

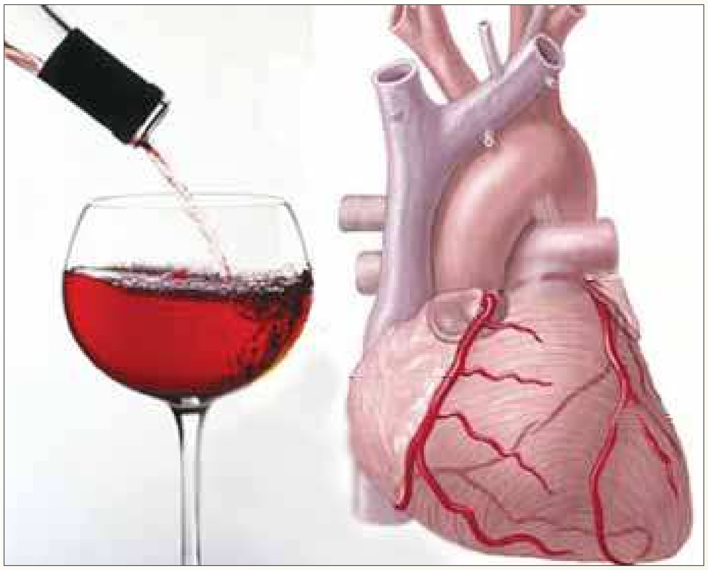
In 2007, the UN's Intergovernmental Panel on Climate Change had warned that an increase of between 1.8° and 5.4°C could trigger massive environmental changes, including melting of the Greenland ice sheet, the Himalayan-Tibetan glaciers and summer sea ice in the Arctic. Moreover, new scientific research suggests the globe is already destined for a greater worldwide temperature rise than predicted. Last month, two scientists from the Scripps Institution of Oceanography and University of California, San Diego published research showing that even if humans stopped generating greenhouse gases immediately, the world's average temperature would "most likely" increase by 2.4°C by the end of this century.

From degrading wine to new cardiac drugs

There is new hope for heart attack patients. A new drug that can switch on an alcohol-degrading enzyme found in red wine may help prevent heart attack damage, according to a new study reported in the journal *Science* (12 September 2008). The paper reports that the enzyme aldehyde dehydrogenase 2 (ALDH2), which plays a key role in processing alcohol in the human body, clears harmful toxins produced in cells when blood flow is blocked in the heart—and a new drug can switch it on.

Indications of the positive role of alcohol, especially red wine in preventing heart diseases has been known earlier. Heart cells exposed to ethanol in the laboratory has been known to recover better when the flow of oxygenated blood to them is blocked. The *Science* paper suggests that ALDH2 may contribute to wine's beneficial effects. The enzyme, activated as cells work to clear alcohol, also eliminates toxic byproducts from the breakdown of fats in cells during a heart attack—thereby reducing damage to this vital organ.

When blood flow to the heart stops during a heart attack, free radicals accumulate in cells, damaging critical fats and proteins and increas-



The enzyme ALDH2 in red wine may contribute to its beneficial effects on heart. A new drug can switch on the enzyme in heart attack patients to reduce damage to heart muscles.

ing the chance of premature cell death. ALDH2 probably helps heart cells survive by repairing some of the damaged fats, according to the study.

Being aware of the fact that alcohol triggers the protective effects of ALDH2 during a heart attack, researchers looked for drug alternatives that could switch on the enzyme. The synthetic compound 'aldA1' was found to directly bind ALDH2, enhancing its activity. When injected directly into the hearts of live healthy rats five minutes before blood flow blockage was induced, aldA1 reduced cardiac damage by 60 percent. Although these results are promising, according to the researchers, adapting this therapy for intravenous or oral use in humans will be a challenge.

However, the researchers remain optimistic about the newly identified drug, especially for patients in East Asia where 40 percent of the population has non-functional ALDH2 due to a gene mutation. Aside from enhancing ALDH2 activity two-fold in normal rat hearts, aldA1 can actually restore full function to the mutant form of the enzyme. For populations from East Asian countries, including China, Japan and South Korea, this could mean a reduction in cardiac damage following heart attacks and augmentation of current therapies for angina, or chest pain. Currently, nitro-glycerine (which dilates blood vessels) is used to treat heart patients who have chest pain. The drug aldA1 may even have beneficial effects for those angina patients carrying the normal version of the enzyme but who have become immune to nitro-glycerine's effects. The researchers are hopeful that with continued study, it may be possible to design drug modifications that will enhance the beneficial effects of aldA1. ■

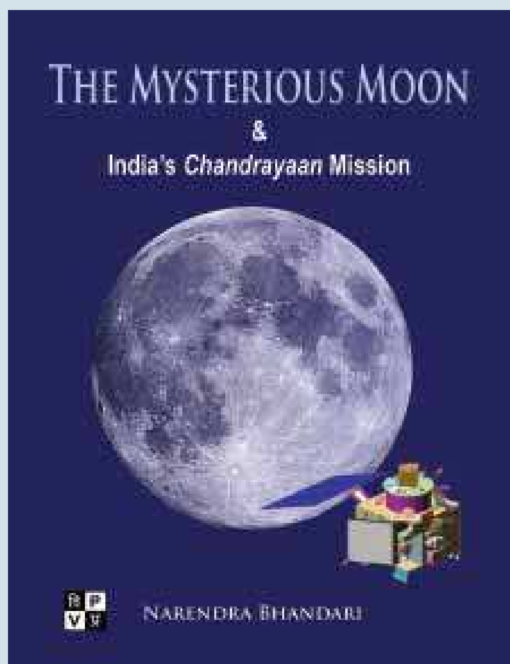
The Mysterious Moon & India's *Chandrayaan* Mission

by Narendra Bhandari

Vigyan Prasar has brought out this publication on the eve of the launch of *Chandrayaan*-1. Professor Narendra Bhandari, a senior scientist from Physical Research Laboratory, Ahmedabad, who has done pioneering work in the study of Moon and who was associated with *Chandrayaan*-1 mission from the concept phase.

This book presents, in simple language, the motivation for this mission to Moon in the framework of the unresolved problems in lunar science. Meant mainly for the inquisitive students, the subject is dealt with a view to highlight the science aspects and in this respect it is different from the information available in other publications or on the web.

> "Professor Bhandari's simple style of writing would make even a layman evince keen interest to understand and study the various aspects of the Moon. The book, I am sure, will be a good source of information for not only the general public but also for students intending to take up space and astronomy as a career. I congratulate Professor Bhandari on this magnificent effort and compliment Vigyan Prasar for bringing out this book to reach out to a large number of readers."
>
> — G Madhavan Nair, Chairman, ISRO.



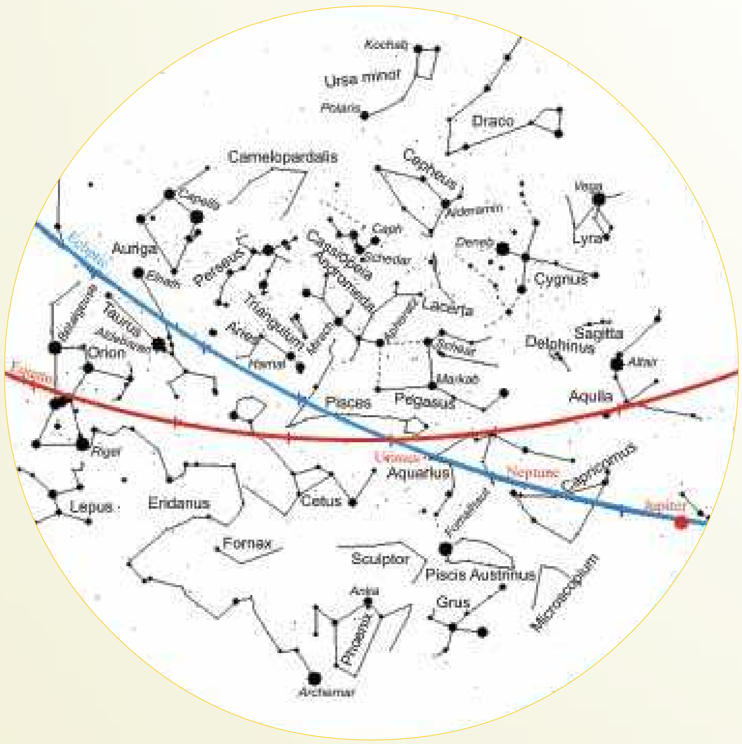
ISBN 978-81-7480-177-7 (Hb)
Pages 92 • Price: 195

Sky Map for November 2008

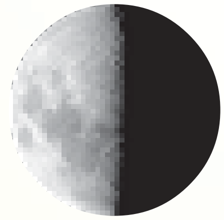
Full Moon

13 November

North



Moon - Last Quarter

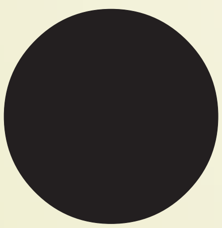


19 November

East

West

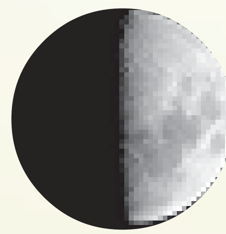
New Moon



27 November

South

Moon - First Quarter



6 November

The sky map is prepared for viewers in Nagpur (21.09° N, 79.09° E). It includes bright constellations and planets. For viewers south of Nagpur, constellations of the southern sky will appear higher up in the sky, and those of the northern sky will appear nearer the northern horizon. Similarly, for viewers north of Nagpur, constellations of northern sky will appear higher up in the sky, and those of the southern sky will appear nearer the southern horizon. The map can be used at 10 PM on 01 November, at 9:00 PM on 15 November and at 8 PM on 30 November.

Tips for watching the night sky :

(1) Choose a place away from city lights/street lights (2) Hold the sky-map overhead with 'North' in the direction of Polaris (3) Use a pencil torch for reading the sky map (4) Try to identify constellations as shown in the map one by one.

Planet/Dwarf planet round-up :

Jupiter : In the constellation Sagittarius (*Dhanu Rashi*) near western horizon.

Uranus : In the constellation Capricornus (*Makar Rashi*) up in the western sky*.

Neptune : In the constellation Aquarius *(Kumbha Rashi)* up in the south-western sky*.

(* Are not naked sky objects.)

Prominent Constellations: Given below are prominent constellations with brightest star therein (in the parenthesis). Also given are their Indian names.

Eastern Sky : Auriga (Capella), Lepus, Orion (Betelgeuse, Rigel, Saiph), Taurus (Aldebaran) / *Vrishabh Rashi*.

Western Sky : Aquila (Altair), Capricorns / *Makar Rashi*, Cygnus (Deneb), Delphinus, Lyra (Vega), Sagitta.

Southern Sky : Cetus (Deneb Kaitos), Eridanus, Fornax, Grus, Microscopium, Phoenix, Piscis Austrinus (Fomalhaut), Sculptor.

Northern Sky : Camelopardalis, Cassiopeia / *Sharmishtha*, Cepheus (Alderamin) / *Vrishaparv*, Draco, Ursa Minor (Polaris) / *Dhurva Matsya* (*Dhurva Tara*).

Zenith : Andromeda / *Devayani*, Aries / *Mesha Rashi*, Aquarius / *Kumbha Rashi*, Lacerta, Pegasus, Perseus, Pisces / *Meen Rash*, Triangulum.

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Astronomy

Editorial (Contd. from page 35)

landing sites in terms of terrain roughness, usable resources, and radiation environment with the ultimate goal of facilitating the return of humans to the Moon. India is all set to launch *Chandrayaan* 1 on 22 October 2008 for simultaneous chemical and mineralogical study of the lunar surface.

What is the *Chandrayaan* 1 mission aimed at, anyway? It is aimed at high-resolution remote sensing of the lunar surface in visible, near Infrared, low-energy X-rays and high-energy X-ray regions. In particular, it would help prepare a three-dimensional atlas (with a high spatial and altitude resolution of 5-10m) of both near and far side of the Moon. Next, it intends to conduct chemical and mineralogical mapping of the entire lunar surface for distribution of elements such as magnesium, aluminum, silicon, calcium, iron and titanium with a spatial resolution of about 20 km and high atomic number elements such as radon, uranium and thorium with a spatial resolution of about 40 km. *Chandrayaan* 1 will orbit the Moon at an altitude of 100 km and will carry eleven scientific instruments (payloads) on-board for this purpose. Five of them are Indian and other six are from European Space Agency (3), NASA (2) and Bulgarian Academy of Sciences (1). Two of the ESA instruments have Indian collaboration. *Chandrayaan* 1 will be launched by the upgraded Polar Satellite Launch Vehicle (PSLV) built by ISRO which has a lift off weight of 316 tonnes. It will take 5½ days to get to the Moon. *Chandrayaan 1* will weigh 1,034 kg at launch and 590 kg in the lunar orbit.

Surely, there are advantages and disadvantages associated with different types of missions, say, orbiter, lander and sample return missions. Orbiter missions have the advantage that they can cover the entire surface of the Moon and provide a global view. Landing and sample return missions provide only local information; but, they can resolve many important questions such as presence and dimension of core, presence of water, and bulk composition of the Moon. Much can be learnt if samples of some critical areas of the Moon can be brought to Earth for laboratory analysis. It is hence desirable that after the *Chandrayaan* 1 mission, the future missions land on the Moon with instruments, carry out experiments, and bring back samples from selected regions of the Moon for laboratory studies. This is why *Chandrayaan* 2, to be launched in 2011-12, will carry a lander / rover.

By simultaneous photo-geological and chemical mapping, it would be possible to identify different geological parameters, which will test the hypothesis for the origin and early evolutionary history of the Moon, and help in determining the nature of the lunar crust. The hypothesis for the evolution of the Moon that is currently accepted is called the Giant Impact hypothesis. It suggests that a body about the size of Mars slammed into Earth shortly after Earth's formation, but only after it had formed an iron core. When the impact took place, it blasted a large part of the Earth into space and the ejecta then began orbiting Earth. The material that blasted off the Earth later coalesced into the Moon. This hypothesis is able to explain (a) the missing Moon iron as most of the material blasted into space would have been depleted in iron after formation of Earth's core; (b) the similarity between Moon rocks and Earth because they came from the same place; and (c) the tilt of the Moon's as well as the Earth's orbit.

But, why this fascination with the Moon, anyway? NASA has embarked on an ambitious programme to establish a permanent base on the Moon; and from there eventually place humans on Mars. It would be of interest to note that the space-faring nations including Russia, China, Japan and India are also considering human flights to Moon and beyond in due course of time. Surely, it is necessary to know the topography and geology of the Moon for this purpose. Then, there is a possibility of water on lunar surface in the polar regions which are permanently shadowed from sunlight. Due to the very slight tilt (only 1.5°) of the Moon's axis, some of the deep craters, particularly near the polar regions never receive any light from the Sun – they are permanently in shadow and can act as permanent traps of water molecules. In such craters scientists expect to find water in frozen form. If there is water ice present on the Moon we will be able to rely on lunar ice, and there will be no need to transport water from the Earth. This is important for a cost-effective lunar habitation. We may even look for new sources of energy, say tapping the reserves of He^3 on the Moon, regarded as an ideal nuclear fuel, being non-polluting and having virtually no by-products.

Yet, how can we justify a poor country like India spending millions on mission to the Moon? Space science and technology has allowed a country like India to provide communications and remote sensing services to people in the remotest corners relatively cheaply and quickly. It is hard to imagine all this happening without investing in space technology. We could have a computer, but we would not be able to get on the internet. It may not be a quick-fix solution to raise people above the poverty line, or improve their health, but would certainly assure the nation of a prosperous future. It could give people a vision of future and help attract young people to study science and engineering. As Carl Sagan once said, it is possible to make a better life for everyone on Earth, and at the same time to reach for the planets and the stars.

❑ Vinay B. Kamble

Vichar Goshthi on '*Hindi me Vigyan lekhan: Sansthagat evam Yaktigat Prayas*'

Vigyan Prasar organised a *Vichar goshthi* (Seminar) on '*Hindi me Vigyan lekhan: Sansthagat evam yaktigat prayas*' on 29 September 2008 at IIM Lucknow, Noida Campus, Noida, as a part of *Vigyan Prasar Rajbhasha Karyakram 2008*.

Inaugural function of the seminar (L to R) - Sri Prem Pal Sharma (speaking), Dr. Subodh Mahanti, Dr. Vinay B. Kamble, Dr. Hari Krishna Devsare, Prof. Lakshman Singh Bisht 'Batrohi', and Dr. Shiv Gopal Mishra

Science communicators, editors, litterateurs, scientists, and writers representing various institutions throughout the country along with independent science writers and translators participated in the seminar. Participants in the discussion included Dr. Hari Krisnha Devsare (Former Fellow, Vigyan Prasar), Dr. Shiv Gopal Mishra (*Pradhanmantri, Vigyan Parishad Prayag,* Allahabad), Dr. R. D. Sharma (Former Director, Publication & Information Division, ICAR, New Delhi), Prof. Lakshman Singh Bisht 'Batrohi' (Director, *Mahadevi Verma Srijan Pith,* Kumaun University, Nainital), Dr. Manmohan Bala (Retd. Wing Commander), Sri Prem Pal Sharma (Joint Secretary, Railway Board, New Delhi), Sri Devendra Mewari (Former Fellow, Vigyan Prasar), Sri R. K. Sahai (Former Sr. Scientist, CSIR), Dr. K.K. Mishra (Reader-F, Homi Bhabha Centre for Science Education, TIFR, Mumbai), Sri Subhash Lakhera (Sr. Scientist, DIPAS, New Delhi), Dr. Madhu Pant (Former Director, Bal Bhawan, New Delhi), Dr. Manoj Patairiya (Scientist 'F' & Director, NCSTC, New Delhi), Sri Satish Chandra Saxena (Former Dy. Director, CSTT, New Delhi), Dr. Vishnu Dutta Sharma (Secretary, Shodh Prakashan Academy, Ghaziabad), Dr. C. M. Nautiyal (Sr. Scientist, BSIP, Lucknow), Dr. Govind Singh (Sr. Journalist, *Amar Ujala*, Noida), Dr. R. K. Mishra (Scientific Officer, CSTT, New Delhi), Sri Surya Kant (Business Manager, Publications Division, New Delhi), Sri Bimal Srivastava (Former G.M., Airport Authority of India, New Delhi), Sri R. K. Anthwal (Editor, *Aavishkar*, NRDC, New Delhi), Mohd. Khalil (Former Scientist 'F', NISCAIR), Smt. Deeksha Bisht (Scientist 'F', NISCAIR, New Delhi), Dr. P. K. Mukherjee (Reader, Dept. of Physics, Desh Bandhu College, New Delhi), Sri Vinod Kumar Misra (Chief Manager, CEL, Ghaziabad), Dr. Vibha Devsare (Litterateur), Sri Manas Ranjan Mahapatra (Editor, NBT, New Delhi), and Sri Dev Vrat Diwedi (Fellow, *Vigyan Parishad Prayag*, Allahabad).

Inaugurating the seminar, Dr. V. B. Kamble, Director, Vigyan Prasar said that we have to evaluate our efforts towards Hindi science writing. He said Hindi could not achieve the gravity that English has! Dr. Kamble also stressed on proper usage of Hindi scientific terminology. Dr. Subodh Mahanti, Scientist 'F' and Chairman, *Vigyan Prasar Rajbhasha Karyasamiti* said in his welcome address that the idea behind organising the seminar was to make a review of the efforts made by institutions and individuals in the field of science popularisation in Hindi and to provide a platform for interaction among science communicators in Hindi. Dr. Mahanti briefly described the efforts made by Vigyan Prasar in creating popular science literature in Hindi.

The participants not only pointed out the lacunae in science communication in Hindi but also suggested ways to improve the situation. Vigyan Prasar plans to bring out a publication based on the papers presented at the seminar for the benefit of young science communicators. All participants emphasised the need of organising more such interaction among science communicators in Hindi in future. Some of the participants suggested that Vigyan Prasar should organise training programmes for young science communicators in Hindi on regular basis. Such efforts would go long way and improve the situation in Hindi science communication.

Participants of the seminar 'Hindi me Vigyan lekhan: Sansthagat evam Yaktigat Prayas'

Sri Nimish Kapoor, Scientist 'C', Vigyan Prasar proposed the vote of thanks to all participants. ■

Astronomy workshop for the VIPNET clubs of Madhya Pradesh

Vigyan Prasar and Yuva Vigyan Manch, Gwalior jointly conducted a five-day astronomy workshop for 60 VIPNET clubs from different districts of Madhya Pradesh from 19-23 September 2008 in Gwalior. The objective was to develop the enthusiasm for astronomy in school-going children. The active clubs were selected by the Yuva Vigyan Manch.

Arvind C. Ranade delivering the lecture at workshop

The workshop was inaugurated by Mr. Subhash Chandra Arora, Joint Director, Public Relations and Mr I. A. Zaidi, District Nodal Officer, Education Department, was present as a special guest. Resource material comprising VP Astronomy Kit and books – *The Sun*, *Venus and its Transits* – were given to each registered participant. Lectures and demonstrations on different topics of astronomy like, 'magnitude scale in astronomy', 'origin of the Universe', 'basics of telescope', 'Sun and the Solar System', 'origin of the Solar System', 'types of eclipses', 'astronomy in different wavelengths', 'constellations and Zodiac', etc., were conducted by Arvind C. Ranade, Scientist (Vigyan Prasar). Demonstration of Astronomy kit, assembling of 39-mm simple refractor, and night sky watching was conducted by Sri R. K. Yadav. The local resource persons Mr. B. Srivastav, Mr. S. K. Jain, and Mr. Jitendra Bhantnagar also spoke on different topics of astronomy. Mr. Hari Mohan Sharma, Chief Editor, *Dainik Bhaskar*, was invited for the special lecture on 'Science and Society'. During the workshop, the participants were taken to the Cancer Hill (near Gwalior) for night sky watching. During the workshop VP video on 'Shukra Paragaman', 'Yek Khagoliya Yikahi Ki Khoj', 'Relativity', 'Aaisa hi Hota Hai', etc., were shown to the participants. In this workshop, 60 simple 39-mm refractor telescopes were assembled by the participants. Arvind C. Ranade from Vigyan Prasar, New Delhi and Mr. Sunil Jain from Yuva Vigyan Manch, Gwalior, coordinated the workshop.

Participant's assembled telescope

Letters to the Editor

Helps to generate knowledge

I am very much pleased to get a copy of *DREAM 2047* every month because this magazine helps me to generate knowledge and spread it among the students and members of Darjeeling and Sikkim Science and Nature Club. I am very curious about the mysteries of science and nature.

Pravin Tamang
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Fitness drill

While at our maternal grandfather's place we went through the article on fitness by Dr. Yatish Agarwal (*DREAM 2047*, August) which was quite educative and interesting. The article provides valuable tips on fighting stress. Such information can go a long way in preventing stress-related problems associated with the present day life style. We would like to receive the journal at the following address to share its contents with other colleagues as well.

Geetika, Madhulika and Ankur
C/o Shri S.N. Agarwal, Mirzapur (UP) 231 001

Improves general knowledge

I am a regular reader of the monthly magazine *DREAM 2047* and find it very informative. It helps me in improving my general knowledge and spreading it among the students.

Dr. H. Nayak
Department of Chemistry, N.C. College, Jaipur-755001 Orissa

Good resource material

I find *DREAM 2047* a very good resource material for inculcating scientific temper among students. Your publications are helpful to teachers as well as undergraduate and postgraduate students.

Dr. Sanjive Shukla
BSNV PG College, Lucknow (UP)