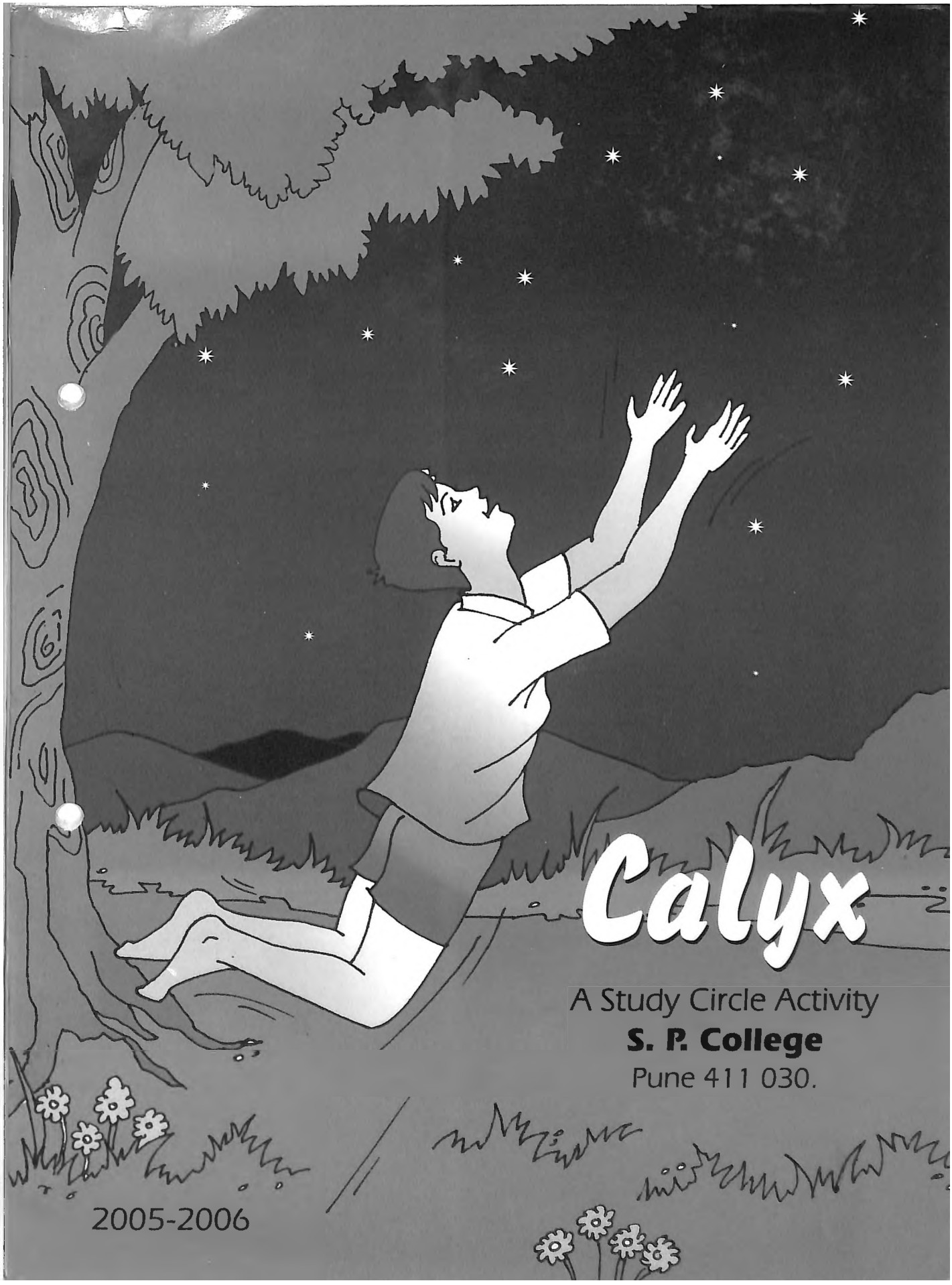

Calyx

A Study Circle Activity

S. P. College

Pune 411 030.

2005-2006

The Study Circle (2005-06)

(From left to right) teachers: Vice-Principal (Science) Dr. V. M. Sholapurkar, Principal Dr. M. A. Pendse, Vice-Principal (Commerce) Prof. U. N. Kivalkar; students: Kaushika Draavid, Kunal Ray (seated), Biswajit Deb, Utsav Vatsyayan, Yashashree Vijapure, Deepshikha Chatterjee, Anuja Bhalkikar, Siona Daniels, Pradnya Khade and Abhay Soman (standing).

Calyx

A Study Circle Activity
(2005-06)

Sir Parashurambhau College, Pune.

calyx n. tech. (pl. **calyxes** or **calyces**) a ring of leaves (sepals) which protects a flower before it opens and later supports the opened flower.

Calyx *will always remain the base upon which beautiful thoughts and ideas blossom.*

Foreword

It is a matter of great pleasure and immense satisfaction to present the second issue of 'Calyx', the student magazine of S. P. College, Pune.

The inaugural issue received tremendous attention, appreciation and applause. The novel concept of offering complete freedom to the bright students of the college to run a magazine devoted to academics, generated a strong wave of enthusiasm among the talented students of all the departments of the college. Inspired by the quality work of the previous batch, the students of the Study Circle of this batch took up the challenge of bringing out an equally qualitative second issue with great zeal, devotion and hard work!

This year, the students decided to have a specific theme for the magazine. After a lot of intellectual churning, they proposed to write articles on 'Nature' —a very deep, intriguing and vast, but attractive and all-pervasive, topic. The great creative minds in all the disciplines—Science, Literature, Music, etc.— have always found their source of inspiration in Nature. The search for truth also ultimately leads one to think on the secrets of nature! Thus, it was a challenging task for these young minds to relate the larger and somewhat abstract concept of Nature to their areas of interest and study and write articles so that they could come up with this special issue on 'Nature'. I am extremely delighted to say that our students accepted this challenge and with tremendous hard work, have produced nine very high quality articles. These articles exhibit amazing variety and touch upon several aspects of Nature like Mathematics in Nature, Nature in Literature, Nature Within—a psychological perspective—Nature and Political Science, etc.

All the articles in the magazine are written by the students without any help from their teachers! The magazine is an experiment of providing the young mind an opportunity to discover things by herself. We are proud of her originality and sincere efforts.

I heartily congratulate all the students of the Study Circle and wish all of them great success! I take this opportunity to thank our Principal Dr. M. A. Pendse for his constant encouragement and support. I am also thankful to the members of the teaching and non-teaching staff of the college for their interest in the activity.

V. M. Sholapurkar
Vice-Principal

Contents

Published by : Principal Dr. M. A. Pendse, S. P. College, Pune - 411 030.
Printed at : Shree Mudran Mandir, 914 Sadashiv Peth, Pune - 411 030.

Nature

Anuja Bhalkikar, Deepshikha Chatterjee and Siona Daniels
S. Y. B. Sc. (Botany and Zoology)

Why is it that most of us feel that we can find spiritual refuge in nature? Why do we treat nature as a heavenly abode? Yes, it is true, peace of mind and body can be found in nature. It is this wonderful sight—the beauties of nature—from which are begotten fantasies that take us onto a wild, happy journey. But scientists have always preferred to stick to reality. They have finally discovered and uncovered secrets and forces in nature that have been, hitherto, unknown and incomprehensible.

There are some forces in nature that surprise and awaken the unscientific, that astonish and leave you spellbound. There is, however, much that is unknown. A journey through the thickets of scientific guesswork and firm evidence leads us to the revelation of certain physico-chemical forces, seen in plants, animals, human nature and what may lie beyond these. Through this piece we are trying to present the physical world in harmony with the living, which in totality, indeed, represents Nature in the true sense.

"Geometry has two great treasures; one is the theorem of Pythagoras; the other, the division of a line into extreme and mean ratio. The first we may compare to a measure of gold; the second we may name a precious jewel."

- Johannes Kepler (1571-1630)

Any objective observation we make about nature must include a discussion of proportion, for it is the rule of proportion in the examination of nature that causes us to observe an organized universe and a universe in chaos, rational and irrational numbers, harmony and discord, truth and falsity. These descriptions are merely proportional effects of the opposition that is inherent in all things.

Harmony is crewed within nature as the Divine Proportion. The divine proportion ascribed to our collective state of observation has been expressed thus: "For of three magnitudes, if the greatest (AB) is to the mean (CB) as the mean (CB) is to the least (AC), they therefore all shall be one."

$AB/CB = CB/AC = 1.618...$

The divine proportion was closely studied by the Greek sculptor Phidias, and as result, it took on the name Phi. Its reciprocal is called phi. **Phi is also referred to as the Golden Mean, the Magic Ratio, etc. It is an inherent and essential part of nature.** It can be found throughout the universe, from the spirals of galaxies to the spirals of a Nautilus seashell,

from the harmony of music to the beauty in art. A botanist will find Phi in the growth patterns of flowers and a zoologist sees it in the breeding of rabbits. The entomologist views it in the genealogy of a bee and the physicist observes it in the behaviour of light and atoms. A Wall Street analyst finds it in the rising and falling patterns of a market. In the ancient times, it was used by Egyptians in the construction of the great pyramids and by Mexicans while building the Sun Pyramid at Teotihuacan. The Parthenon at Athens is a classic example of the use of the Golden Rectangle.

The Golden Ratio is generally believed to have been derived from the Fibonacci Sequence. However historical records show that the number was known long before Fibonacci derived it from the famous sequence.

If we look around, we can find Phi in the opposing spirals of the sunflower, and also in the leaf arrangement on plant stalks. We can even find it in our own body! If we take a ratio, for example, the distance from our head to the toe to the distance from our navel to the floor, the ratio is the Golden Ratio. The same is true of the ratio of distance from the shoulder to fingertips to the distance between elbow to fingertips, and so on. Another amazing example is the pentagram. In it, lines divide themselves into segments according to the divine proportion. It is believed to be the ultimate expression of the divine proportion. Phi was also used by Renaissance artists like Michelangelo, Raphael and Leonardo da Vinci, and by musicians like Mozart, Beethoven and Bach. **Phi, therefore, presents itself in the very physical nature of creation of Nature.** It is seen as the beauty and organization within the cosmos. It is the harmony and glue the keeps Nature united.

We have thus observed that an astonishingly precise pattern or design exists in Nature. That is not all—when we think of the Aurora borealis we can only wonder. **Aurora borealis is a beautiful display of lights seen at the poles, called Northern lights at the North Pole. It is an example of how Nature, in an act of protection, generates so much beauty.**

But how does it happen? It originates in the sun. During huge explosions and flares, large quantities of solar particles are thrown out of the sun into deep space. These plasma clouds travel through space with speeds varying from 300-1000 km/s (over a million km/hr), but even with such speeds it takes these plasma clouds 2-3 days to reach Earth. When they are closing in on earth, they are captured by earth's magnetic field and guided towards earth's two magnetic poles. Northern lights occur as a result of solar particles colliding with the gases in the earth's atmosphere. On their way to the geomagnetic poles the solar particles are stopped by earth's atmosphere, which acts as an effective shield against these deadly particles. When the solar particles are stopped by the atmosphere they collide with the atmospheric gases present and the collision energy between the solar particles and gas molecules is emitted as a photon (a light particle). When we have many such collisions we have an aurora (lights) that may seem to move across the sky. **To see the Aurora borealis with the naked eye, at least 100 million photons have to be generated.**

The beautiful blue sky on a sunny day.... So many poets, artists and suchlike have expressed their admiration for the blue sky. But, do we ever ask why the sky is blue? It is so due to one of nature's physical phenomena—**scattering**. The light reaching the earth consists of all the seven colours of the rainbow and thus appears white. However, as it passes through the atmosphere, scattering takes place. Blue light gets scattered the most, giving the sky the blue colour.

Now, we come to an interesting question: **What will be the colour of the sky on the Moon**—White? Black? Blue? **It is black.** We must remember that the moon lacks an atmosphere. As a result, there will be no scattering of suns light. Due to absence of scattering the sky's colour would be perceived as black.

Thus far, we have discussed a few marvels of nature, but at the macro level. If we consider the **micro level**—the level of atoms and subatomic particles, we encounter certain near impossible scenarios. The behaviour of atoms and various related phenomena we have hardly started understanding and their study belongs to the complex field of quantum physics. One such recently observed phenomenon with great futuristic implications was the **cat state**.

The cat state is the condition of being in two diametrically opposed conditions at once, like up and down, black and white, dead and alive. In this case, the atoms are spinning clockwise and counterclockwise at the same time. This fall scientists announced that they had half a dozen Beryllium atoms in the cat state. Atoms, in this condition, exhibit an important feature—perfect synchrony. The atoms do whatever it is that they do, together, in perfect synchrony, whether they are across a test tube or across a galaxy. This leads to the idea that measuring the properties of one particle could instantaneously change the properties of another one far away. The notion of particles spinning in two directions at once is strange. It has great futuristic applications for making new age computers, electronics and other equipments.

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When we look around and see plants we get a sense of tranquillity, peace and pleasant inaction. This, however, does not mean that plants are inactive or imperceptive—far from that. They too can feel and respond to the physical elements and other stimuli as we do.

Plants anywhere on this earth grow with their shoots growing upwards and their roots downwards. Why is this so? This is so **because plants can sense gravity.** But how do plants sense gravity? This has been explained very well in some lower plants like mosses. Mosses on earth grow away from earth's gravity and thus have a definite configuration on earth. In space where there is no gravity, they grow in odd spirals. Possible explanation is as follows: Amyloplasts are tiny starch-filled particles that float within cells. They are heavy and gravity pulls them down. When normal gravity vanishes, the position of starch particles is determined solely by

structures inside cells, e.g. cytoskeleton, which is a network of fibres and gives cells a definite shape and holds nucleus and other structures in place. Probably, cytoskeleton causes amyloplasts to cluster together. Perhaps calcium ions flowing in and out of cells control the growth direction. Clustering affects calcium ions and instructs moss filaments to curve in clockwise direction.

In higher plants shoots grow up and roots grow downwards because of response to gravity rather than light. Shoots are thus negatively gravitropic and roots are positively gravitropic. Cells in the central region of root cap appear to be the organ that senses the pull of gravity. Root cap senses force and transforms that to a signal, which helps growing root region understand in what direction to grow. Growth regulators and ions play an important role.

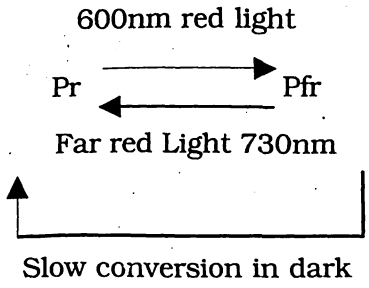
It is a known fact that plants trap light energy and convert it into food (starch) by a process called photosynthesis. But do we also know that plants can actually **regulate their growth activities** depending on the nature of light? This is possible due to a chemical called phytochrome.

Phytochrome is a protein with chromatophore (pigmented portion) prosthetic group that resembles in basic structure the open chain tetrapyrrole chromophore of the algal pigment phycocyanin. Phytochromes have specially been observed in germinated seedlings. They, however, mediate several responses as listed.

1. Elongation (leaf, petiole, stem)
2. Hypocotyl hook unfolding
3. Sex expression
4. Bud dormancy
5. Root development
6. Rhizome formation
7. Leaf abscission
8. Bulb formation
9. Succulence
10. Enlargement of cotyledons
11. Seed germination
12. Flower induction
13. Formation of tracheary elements
14. Changes in rate of cell respiration
15. Synthesis of anthocyanin
16. Increase in protein synthesis
17. Increase in RNA synthesis
18. Auxin catabolism
19. Permeability of cell membranes

20. Photoperiodism
21. Seed respiration
22. Changes in membrane conformation
23. Changes in turgor

It has been suggested that phytochromes exits in two forms, Pfr and Pr, which are interconvertible.



Pfr is the biologically active form of phytochrone, which brings about the responses enlisted, while Pr inhibits those responses. In red light (600nm) Pr is quickly converted to Pfr, while far red light (730nm) quickly converts Pfr to Pr. Some Pfr is lost by slow conversion to Pr in darkness. Thus we can say that, with reference to germination and other processes, red light has a positive effect on plant as more of Pfr is formed in it, while far red light has an inhibitory or negative effect.

Music has a soothing effect on us as we listen to it. It rejuvenates our minds and fills our bodies with a new energy. But **can plants respond to music?** Surprisingly, they can. It has been observed that when certain tunes are played plants grow more vigorously. Tomatoes exposed to certain melodies grew 2 ½ times as large as those untreated. It is believed that each note chosen to make the tune corresponds to an amino acid in a protein while the entire tune corresponds to the entire protein. How exactly the tune stimulates protein synthesis is not known. However, we can make some of our own deductions.

To understand the process, we first must understand the process of protein synthesis. The information regarding a particular protein is present in the DNA inside the nucleus. Protein synthesis is initiated when this information is transcribed onto another molecule called m-RNA by the **process of transcription**. In this process a strand of m-RNA complimentary to that region of DNA containing the necessary information is produced. Each of the three nitrogen bases on m-RNA is called codon, corresponding to an amino acid. Formation of m-RNA is initiated when an enzyme called RNA polymerase with an a factor locates and then attaches itself to a promoter region of DNA. Later, the m-RNA molecule leaves the nucleus and protein synthesis starts when small moleculas called t-RNA fetch amino

acids corresponding to each codon, which are then linked up to form the whole protein. This process is called **translation.**

We can thus correlate and say that the starting note consisting of some typical sound vibrations stimulates RNA polymerase to attach to a certain promoter, corresponding to a particular protein, on the DNA. This initiates the m-RNA synthesis. The notes following correspond in length to the real time taken for each amino acid to come after the next. As length of each note is fixed and each corresponds to a particular amino acid, the entire process is expedited. Thus protein synthesis is faster. Also, by playing the whole tune anytime a particular protein can be synthesized in more amount. Sternheimer claims that when plants hear the appropriate tune they produce more of that protein. Hence desirable plants can be grown to a greater extent and undesirable plants removed. Using simple physics to compose the proper tune can do this. We can, thus, indeed serenade the plants to grow!

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After a hard days work and a difficult ride back home, the familiar bark and a wagging tail makes us instantly forget our frustrations and worries. Do animals possess the power to heal? Yes, they do and this is the reason why animals are used in different rehabilitation methods. **Dolphin Theory** is one such rehabilitation method, which enables special children to find, together with dolphins, a new direction towards success. Dolphins are also associated with the treatment of humans with psychological diseases. An American psychologist, Dr. David E. Nathanson, president of Dolphin Human Therapy, developed this extraordinary kind of therapy more than 25 years ago.

The inspirational elements of this Dolphin Assisted Theory employed by dolphin specialists are based on theories that have been useful in several other types of rehabilitation therapies. The key elements are basically reward and motivation. The subject is asked to perform certain tasks that challenge him/her in areas such as speech or language or motor skills. Mastery of those tasks result in the reward of participation in a behaviour with the dolphins.

Other kinds of dolphin therapies include the use of dolphin communication. Dr. Horace Dobbs, working in U.K., made impressive strides with Dolphin Therapy for people suffering from conditions such as anorexia nervosa. He reasoned that since music is known to alter moods and affect our well being, dolphin's sonic communications could play a part in alleviating depression. This is because sonic waves interact with brain waves in humans, which helps in alleviating depression. In his search to find an alternative to taking patients into sea to swim with dolphins, **Dr. Dobbs developed the concept of 'audio pill', which captured the healing essence of dolphins. He took the concept one step forward by distributing thousands of copies of an audiocassette called 'Dolphin Dreamtime' which takes listeners on a mental journey into the dolphin's realm. To swim with them.**

Dolphin human therapy also involves the treatment of special children such as those suffering from cerebral palsy. The theory focuses on encounters of children with dolphins. Accompanied by skilled trainers the children work on a swimming dock according to a schedule with at least one dolphin. Now the question arises as to how the children respond to this treatment. The answer to this question lies in the nature of dolphins, who are extremely gentle and who, in a playful way, miraculously and immediately realize the children's deficiencies. The children get affection. In this way they become less shy, especially towards these beautiful animals, and re-establish contact with their surroundings.

The diseases treated with the aid of dolphins are Autism, Ataxia, Attention deficit disorder, Brain tumour, Cerebral palsy, Cri-du-chat, Dyslexia, Leukaemia, Meningitis, Mental retardation, Paralysis, Polio, Speech disorder, Traumatic brain injury, etc. Dolphin therapy does not claim to cure diseases. Nevertheless research has shown that **by working with dolphins, disabled children are able to learn up to four times faster and more intensively when exploring the surroundings.** In order to achieve positive treatment, dolphin therapy should be carried out for not less than two weeks. Another positive aspect is that the whole family can be integrated into the therapy, which can lead to basic progress in the future. Siblings of young patients also enjoy the company of dolphins.

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For thousands of years we humans have lived on this planet. Many amongst us have objectively looked at Nature and admired it, but we do not seem to realize that we, too, are a part of Nature. We observe it as something different from us. Yet if we just opened our minds, it would dawn on us that we are as much a part of nature as plants and animals are.

Have we ever considered why we seem to feel a person's distress when she/he is troubled? Most people would answer by saying that this happens because of the human ability to feel. However, the answer is more biological. For many decades scientists believed that cultural evolution was divorced from biological evolution. Recent discoveries on **mirror neurons** have proved them wrong.

Neurons are a type of cells that make up the brain and our nervous system. Mirror neurons are highly specialized and complex neurons with special abilities. They can simulate what a person observes and the simulation involves the person itself. These neurons are found in several areas of the brain. They fire in response to a chain of actions linked to intentions. Because of these neurons, you know how a person feels, because you literally feel what that person feels. The multiple mirror neuron systems in the human brain specialize in carrying out and understanding not just the actions of others but also their intentions, the social meaning of their behaviour and their emotions.

An interesting feature about mirror neurons is that when they are activated, the person is incapable of showing any movement. But let us not suppose that mirror neurons are found exclusively in humans. They are also found in monkeys, apes and dolphins, although not in a very developed condition. In fact, mirror neurons were first discovered in a monkey. An experiment was carried out in which the monkey's brainwaves (generated by tiny impulses travelling through his brains neurons) were recorded while he moved. A surprising thing was then observed. A young student entered the lab eating an ice cream. As the monkey observed the student the recording device went berserk, even though the monkey showed no movement at all! The neural activity, after several years of hard work, was attributed to the mirror neurons, which simulated ice cream eating in the monkey's mind involving him, so that he, too, experienced the satisfaction that the student himself felt.

Mirror neurons can explain some very common reactions in us. If we see a person choking on her food we can feel that person's distress and are quite often immobilized for a second or two. When we are watching a match on T.V. we remain glued to the set and feel the adrenaline pumping. All of this is due to the mirror neurons. But we also observe that everyone does not enjoy a match. We must remember that a person's mirror neurons are unique, and hence a person's response to a particular situation is also unique. Still, there is one caveat. Mirror neurons work best in real life, when people are face-to-face. Virtual reality and videos are shadowy substitutes. Therefore, reading a book or watching T.V. does not trigger mirror neurons as effectively as something that you observe in front of you. Nevertheless, observing violence on T.V. does trigger mirror neurons to a certain extent and hence these things are improper for child viewing.

Thus mirror neurons help us understand the very nature of us humans beings, and make us realize the reason why we are cultural and can feel and think. As mirror neurons are a part of our biological constitution, we can clearly say that cultural and biological evolution are intimately linked. We can also see that in humans the brain is the controlling organ and as we try to delve deeper into its complexities fascinating facts are revealed.

Lastly, there are many things in nature that are unknown and unexplained yet. Relatively recent discoveries of the Bigfoot in Kerala, the Yeti in the Himalayas, the Bermuda triangle in South Atlantics and so on have left many scientists clueless. A number of 'eyewitnesses' are ready to come forward and claim their existence even though the investigations carried out so far suggest that they can only be myths.

Conclusion

The dictionary meaning of the word 'nature' is: 'the physical world that surrounds us'. But this phrase alone cannot sum up the vastness of this concept. As Pascal said, **"Nature is the infinite sphere in which the**

centre is everywhere and the circumference nowhere." Nature not only includes plants, animals and human beings, among other things, but also the relation that exists between them. There is something that holds all of it together. Further, there is a harmonious design in nature: nothing is haphazard. It can not only create but also protect. It is a source of inspiration and beauty.

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निसर्गाचं मानवाशी नातं : कालिदासाचा विचार

यश:श्री जयंत विजापुरे, रेणुका सतीश पंचपोर
द्वितीय वर्ष साहित्य (संस्कृत)

माणसाला जन्मापासून मृत्यूपर्यंत जर कोणी साथ देत असेल, तर तो निसर्ग होय, म्हणूनच निसर्ग व मानव यांच्यात अतूट नाते आहे. या नात्याबाबत मानव नेहमीच अनभिज्ञ असतो. मात्र निसर्ग वेगवेगळ्या रूपांत माणसाला साथ देत असतो. आईच्या उदरातून लहानगे अर्भक जन्माला येणे हा निसर्गाचा चमत्कार आणि नैसर्गिक आपत्तींमुळे मानवाचा सर्वनाश हेही याच निसर्गाचे अनोखे रूप! असा हा बहुरूपी निसर्ग झाडे-झुडपे, नद्या, झरे, डोंगर, आभाळ इत्यादी असंख्य रूपांतून मानवाला आजतागायत भुरळ पाडत आला आहे. बालपणी निसर्गातील प्रत्येकच गोष्टीबाबत माणसाला नाविन्य वाटतं. घरातील सिमेंट-काँक्रिटच्या अंगणात खेळण्यापेक्षा बागेतील हिरव्यागार गवतावर मनमुराद खेळण्याचा आनंद काही वेगळाच. तारुण्यातही पहिलंवहिलं प्रेम लाल गुलाबाच्या साहाय्यानेच व्यक्त केले जाते. नंतर, माणसाला जेव्हा रोजच्या धकाधकीच्या जीवनातून थोडासा आराम हवा असतो, तेव्हाही त्याला निसर्गाच्या सहवासाचीच ओढ लागते. म्हणजेच माणसाला जीवनाच्या प्रत्येक टप्प्यावर निसर्गासारखा सच्चा सोबतीच साद घालत असतो.

प्राचीन काळापासूनच माणसाने निसर्गाचे सार्वभौम सामर्थ्य मान्य केले आहे. या गोष्टीचा विचार करताना आपण नकळत मानवाच्या भूतकाळात, म्हणजेच अश्मयुगात जाऊन पोहोचतो. तेव्हा त्या काळातील निसर्गाबद्दलचे कुतूहल आपोआप जागृत होते. प्राचीन काळात माणसाच्या मनात निसर्गाबद्दल देवत्वाची भावना होती. मुसळधार वर्षणाऱ्या, वृक्ष-लतांचे त्यामध्ये भक्षण करणाऱ्या, आपल्या कोपाने तप्त होऊन सजीवमात्रांस दुष्काळात तडफडवणाऱ्या या निसर्गाच्या रौद्ररूपाला माणूस नेहमीच घाबरत आला आहे. परंतू, जेव्हा त्याने अग्नीचा शोध लावला, अग्निप्रज्वलनाची क्रिया आत्मसात केली, तेव्हा मग त्याने अग्नीचा संरक्षण, अन्न शिजवणे, इत्यादींसाठी लीलया वापर सुरू केला. इथेच सुरू झाला, मानवी प्रगतीचा प्रवास ! निसर्गाच्या कोपाला घाबरणाऱ्या माणसाचे पंचमहाभूतस्वरूप निसर्गाशी सख्य कधी व कसे जोडले गेले, हे त्यालासुद्धा कळले नाही. निसर्गाशी मैत्री झाल्यावर माणूस त्याला 'हितचिंतक', 'देव' असे संबोधू लागला. पुढे नवनवीन शोध लागल्यावर माणसाच्या निसर्गाबाबतच्या भ्रामक समजुती नाहीशा झाल्या आणि त्याच्या विचारांना एक स्पष्टपणा आला. या विचारांना 'साकार' रूप देण्यासाठी शब्द-निर्मिती झाली आणि हळूहळू 'देवभाषा' म्हणून गौरवलेल्या 'संस्कृत भाषे' चा विकास होत गेला.

शब्दांच्या साहाय्याने साहित्यातून ऋण व्यक्त करण्याचा माणसाने नेहमीच प्रयत्न केला आहे. संस्कृत साहित्यकार यामध्ये अग्रगण्य मानले जातात. किंबहुना संस्कृत साहित्य हे निसर्गाधिष्ठित आहे, असे म्हटल्यास वावगे ठरणार नाही. निसर्गदेवतेची सतत कृपादृष्टी लाभावी, यास्तव ऋषीमुनींनी आपल्या ऋचांतून निसर्गाची स्तुती वर्णिली आहे.

तत्सूर्यस्य देवत्वं तन्महित्वं मध्या कर्तो विततं सं ज भारा ।

- (ऋग्वेद - १.११५.४)

अर्थात् सूर्याचे देवत्व व मोठेपणा हाच आहे, की तो उगवल्यावर रात्र अंधाराचे जाळे विणण्याचे काम मध्येच आवरून घेते अशा प्रकारच्या ऋचांमधून ऋषी सूर्याचे सामर्थ्य वर्णन करतात.

अस्य त्वेषा अजरा अस्य भानवः सुसंदृशः सुप्रतीकस्य सुद्युतः ।
भात्वक्षसो अत्यक्तुर्न सिन्धवोऽग्ने रेजन्ते अससन्तो अजराः ।।

- (ऋग्वेद - १.१४३.३)

येथे ऋषींनी अग्नीच्या तेजोमय आणि अविरत ज्वालांना खळाळत वाहणाऱ्या नदीची उपमा दिली आहे. येथे वर्णन केलेले अग्नीचे रूप मनाला भावते.

अशाप्रकारे निसर्गवर्णनातूनही काव्याचा आणि साहित्याचा उगम झाला, असे म्हणता येईल. अभिजात संस्कृतमधील साहित्यकारसुद्धा निसर्गाची वर्णने करण्यात मागे नाहीत. नभोमंडलात विखुरलेल्या असंख्य ताऱ्यांप्रमाणे संस्कृत साहित्यात ठिकठिकाणी आढळणाऱ्या निसर्गवर्णनांमुळे 'संस्कृत साहित्य' अतिशय तेजोमय, प्रकाशमान वाटते. 'निसर्गकवी' म्हणून ओळखला जाणारा कालिदास तर माणूस व निसर्ग यांमधील सीमारेषाच नाहीशी करतो. तो कथाभागाइतकेच महत्त्व निसर्गवर्णनाला देतो. संस्कृत साहित्यात इतरही अनेक कवींनी निसर्गवर्णने रेखाटली आहेत. त्यांमध्ये प्रातिनिधिक म्हणून कालिदासाच्या 'रघुवंश', 'कुमारसंभव' या काव्यांत व 'अभिज्ञानशाकुन्तलम्' नाटकात रेखाटलेल्या निसर्गवर्णनाचा आढावा प्रस्तुत लेखात घेत आहोत.

'दीपशिखा कालिदास' अशी सार्थ पदवी कालिदासाला प्राप्त करून देणारी त्याची महान कलाकृती म्हणजे 'रघुवंश', पंचमहाकाव्यांमध्ये अग्रेसर मानल्या जाणाऱ्या या काव्यांमध्ये, रामायणात न सापडणारी दिलीप, रघु वगैरे राजांची हकीकत, त्यांचे पराक्रम सांगितले आहेत. यामधील दुसऱ्या सर्गात कालिदासाने केलेल्या निसर्गवर्णनातून असे दिसते, की मानव व निसर्ग या दोन भिन्न गोष्टी नसून एकच आहेत ! तसेच राजा दिलीप व सिंह यांच्या संवादातून मनुष्य व मनुष्येतर प्राणी यामधील मित्रत्वाची भावना कालिदासाने यशस्वीरीत्या उलगडून दाखवली आहे. सर्गाच्या सुरुवातीलाच वसिष्ठ ऋषींच्या 'गाई'ला कालिदास 'वसुंधरे' ची उपमा देतो. कुठलीही अपेक्षा न बाळगता, आपल्या अमृतासम दुधाने बहुसंख्य प्राणिमात्रांना पोषण देणाऱ्या गाईला कालिदासाने दिलेली वसुंधरेची उपमा अतिशय समर्पक वाटते. निसर्गाने या सृष्टीतील प्रत्येक जीवाला काही ना काही गुण, वैशिष्ट्य बहाल केले आहे, हे कालिदास अतिशय योग्य प्रकारे जाणतो. जसे - हत्तीला सामर्थ्यसंपन्न बनविले, तर छोट्याशा सशाला वेगाने पळण्याचे कौशल्य दिले. त्यांची हीच वैशिष्ट्ये मनुष्यांमध्येही कशी पाहायला मिळतात, याचे वर्णन करण्यात तर कालिदास अतिशय वाकबगार ! एके ठिकाणी तो दिलीप राजाला मदावस्थेतील गजराजांची उपमा देतो !

सन्यस्तचिह्नामपि राजलक्ष्मी तेजोविशेषानुमितां दधानः ।
आसीदनाविष्कृतदान राजिरन्तर्मदावस्य इव द्विपेन्द्रः ।।

- (रघुवंश, दुसरा सर्ग, सातवा श्लोक)

'हत्ती' हे 'ऐश्वर्या' चे, 'वैभवा'चे, 'सामर्थ्या'चे प्रतीक म्हणून मानले जाते. 'दिलीप' राजाही अतिशय सामर्थ्यवान, ऐश्वर्यसंपन्न असल्याने त्याला दिलेली गजराजाची उपमा अतिशय चपखल बसते.

उत्तुंग व्यक्तिमत्त्व लाभलेल्या दिलीप राजाचा मनुष्यांप्रमाणेच निसर्गातील वृक्षवेली कसा आदर करतात, याचे उत्कृष्ट वर्णन इथे सापडते -

विसृष्टपार्श्वानुचरस्य तस्य पार्श्वद्रुमाः पाशभृता समस्य ।
उदीरयामासुरिवोन्मदानामालोकशब्दं वयसां विरावैः ।।

- (रघुवंश, दुसरा सर्ग, श्लोक क्र. ९)

म्हणजेच, दिलीपासारख्या रुबाबदार व्यक्तिमत्त्वाच्या राजाला पाहून वृक्ष-वेलींवर बसलेले. पक्षी किलबिलाटांनी जणू काही जयजयकारच करतात ! योग्यतेची, उत्तुंगतेची पारख असणाऱ्या वृक्षांना, पक्ष्यांना कालिदासाने माणसांच्या पंक्तीत नेऊन बसविले आहे. असेच आणखी एक वर्णन आपल्याला आढळून येते.

मरुत्प्रयुक्ताश्च मरुत्सखाभं तमर्च्यमाराद भिवर्तमानम् ।
अवाकिरन्बाललताः प्रसूनैराचारलाजैरिव पौरकन्या ।।

- (रघुवंश, सर्ग २, श्लोक क्र. १०)

अर्थात्, दिलीप राजा वसिष्ठांच्या गाईसमवेत बनातून जात असताना आजूबाजूच्या लता, वृक्ष त्याच्यावर पौरकन्यकांनी लाह्या उधळाव्यात, त्याप्रमाणे त्याच्यावर फुले उधळीत होत्या. यातून जणू त्या आपल्या लाडक्या, दैदिप्यमान राजावरील स्नेहभावच व्यक्त करतात, असे दिसते.

याच सर्गामध्ये कालिदासाने अतिशय शिस्तप्रिय राजाला साजेशी अशी वरुणदेवतेची व्यक्तिरेखा उभी केली आहे. अशी सामर्थ्यवान वरुणदेवता उन्हामुळे दमलेल्या अशा दिलीप राजाचा श्रमपरिहार करत असे. ही देवता जेव्हा वनात येते, तेव्हा तिच्या धाकामुळे दावाग्नी शांत होतो, तसेच प्रबळ प्राणीदेखील दुर्बल प्राण्यांना त्रास न देता नीट वागत, असे कालिदास म्हणतो.

ज्याप्रमाणे एखादा गुरु आपल्या शिष्याची परीक्षा पाहतो, अगदी त्याचप्रमाणे वसिष्ठ ऋषींची गायही राजाची परीक्षा घेते, असे वर्णन इथे आढळते. त्यासाठी ती एकदा हिमालयाच्या गुहेत प्रवेश करते. राजा बेसावध असताना एक सिंह तिच्यावर झडप घालतो. काही क्षणानंतर राजाला झालेला प्रकार समजतो. तेव्हा बाणांच्या टोकांशी बोटे चिकटल्यामुळे असहाय्य झालेल्या राजाला कालिदास मन्त्रौषधीनी जखडल्या गेलेल्या सर्पाची उपमा देतो -

बाहुप्रतिष्ठम्भविवृद्धमन्युरभ्यर्णमागस्कृतमस्पृशद्भिः ।
राजा स्वतेजोभिरदह्यतान्तर्भोगीव मन्त्रोषधिरुद्धवीर्यः ।।

- (रघुवंश, २ रा सर्ग, श्लोक क्र. ३२)

ज्याप्रमाणे सर्प जरी शक्तिशाली असला, तरी मन्त्रौषधींच्या प्रभावामुळे समोर असलेली शिकार करू शकत नाही, अगदी त्याचप्रमाणे हा दिलीप राजाही हतबल झालेला असावा, असे कालिदासाला सुचवायचे असावे.

एकेठिकाणी 'देवदार' नावाच्या वृक्षाला साक्षात् शंकर व पार्वतीने आपला पुत्र मानले आहे, असा उल्लेख आढळतो. एवढेच नव्हे, तर पार्वतीने त्या वृक्षाला खास सुवर्णकलशांतून पाणी घालून वाढवले आहे, असाही उल्लेख आढळतो

अमुं पुर पश्यसि देवदारुं पुत्रीकृतोऽसौ वृषभध्वजेन ।
यो हेमकुम्भस्तननिःसृतानां स्कन्दस्य मातुः पयसां रसज्ञः ।।

- (रघुवंश, सर्ग २, श्लोक क्र. ३६)

सुवर्णभांड्यातील पाणी आरोग्यदायी असते, हे तर आपल्याला माहितच आहे. आपली आई ज्याप्रमाणे आपल्याला साधे-साधे पदार्थही अधिकाधिक पौष्टिक बनवून देते, त्याप्रमाणेच पार्वती आपल्या 'देवदार' नावाच्या वृक्षरूपी पुत्राच्या आरोग्याबाबत दक्ष आहे, असे जाणवते. इथे कालिदास निसर्ग व माणसाच्या आहाराच्या बाबतीतही यत्किंचित फरक दाखवत नाही, असे दिसून येते. पुढे एके ठिकाणी जेव्हा सिंह धेनूला राजाच्या हवाली करण्यास नकार देतो, तेव्हा राजाला सर्वप्रथम त्या धेनूच्या वासराची चिंता वाटते. त्याला वाटणाऱ्या या काळजीवरून कालिदास राजाच्या व्यक्तिमत्त्वातील, निसर्गातील पशु-पक्ष्यांबाबत असणारा हळुवारपणा सूचित करतो. तसेच, मनुष्यामधील गुरु - शिष्य, माता-पुत्र इ. नाती केवळ मनुष्यापुरतीच मर्यादित नसतात, तर मनुष्येतर प्राण्यांमध्येही प्रबळतेने उपस्थित असतात, ही जाणीव करून देतो.

या सर्गामध्ये कालिदासाने सिंहाच्या आवाजाला दिलेली एक उपमाही लक्ष वेधून घेते -

एतावदुक्त्वा विरते मृगेन्द्रे प्रतिस्वनेनास्य गुहागतेन ।
शिलोच्चयोऽपि क्षितिपालमुच्चैः प्रीत्या तमेवार्थमभाषतेव ।।

- (रघुवंश, सर्ग २, श्लोक क्र. ५१)

गुहेमध्ये सिंह व राजा यांचा संवाद चालू असताना सिंहाचा आवाज आजूबाजूला असणाऱ्या पर्वतांवर आदळून प्रतिध्वनी निर्माण करत होता. तेव्हा सिंहाने उच्चारलेले शब्द हे पर्वताकडूनही उच्चारले जात आहेत की काय असा राजाला भास होतो. सिंहाचे बोलणे राजाच्या मनावर बिंबवायचे होते म्हणून कदाचित 'सिंह व पर्वत, दोघेही जणू एकच गोष्ट राजाला सांगत होते,' अशी कल्पना कालिदासाने केली आहे.

संतानप्राप्त्यर्थ व्रताचरण केल्यामुळे कृश झालेल्या राजाला कालिदास द्वितीयेच्या बारीक चंद्रकोरीची उपमा देतो.

तमाहितौत्सुक्यमदर्शनेन प्रजाः प्रजार्थव्रत कर्शिताङ्गम् ।
नेत्रैः पपुस्तृप्तिमनाप्नुवद्भिर्नवोदयं नाथमिवौषधीनाम् ।।

- (रघुवंश सर्ग २, श्लोक क्र. ७३)

राजाच्या शरीरयष्टीचे वर्णन करणारी ही उपमा अतिशय चपखल बसते.

त्यानंतर लगेचच कालिदास राजधानीला पोहोचलेल्या राजाला साक्षात नागराजाची उपमा देतो-

भुजे भुजङ्गेन्द्रसमानसारे भूयः भुमेर्धुरमाससञ्ज ।

- (रघुवंश सर्ग २, श्लोक क्र. ७४)

ज्याप्रमाणे नागराजाने संपूर्ण वसुंधरेची धुरा आपल्या मस्तकावर पेलून धरली आहे, त्याचप्रमाणे राजानेही आपल्या राज्याची जबाबदारी आपल्या मस्तकावर घेतली आहे, असे कालिदासाला सुचवायचे असावे.

अशी अजूनही वर्णने रघुवंशाच्या इतर सर्गांतही आढळतात, परंतु दुसऱ्या सर्गातील, निसर्गवर्णने मानवाशी जास्त संलग्न आहेत असे वाटते.

कालिदासाच्याच 'कुमारसंभव' महाकाव्यातही निसर्गाची जणू चालणारी-बोलणारी जिवंत रूपे आढळून येतात. शंकर-पार्वतीचे मिलन हा कथेचा मूळ गाभा होय. यामध्ये कालिदासाने एखाद्या बलशाली पुरुषाचे वर्णन करावे, त्याप्रमाणे हिमालयाचे वर्णन केले आहे. हिमालय व त्याच्या आजूबाजूच्या प्रदेशातील पर्वत म्हणजे भारतभूच्या उत्तरेकडील सीमेचे संरक्षण करणारी सेनाच ! पूर्वेकडून येणारे समुद्र हिमालयाचे चरण धुतात, तर पश्चिमसागर त्याला संपूर्ण स्नान घालतात, अशा सुंदर कल्पनेतून कालिदास हिमालयाचे व्यक्तिचित्र रेखाटतो.

अस्त्युत्तरस्यां दिशिदेवतात्मा
हिमलयो नाम नगाधिराजः ।
पूर्वापरौ तोयनिधीवगाह्य
स्थितः पृथ्विव्यारिव मानदण्डः ।।

- (कुमारसंभव, सर्ग १, श्लोक क्र. १)

पुढे कालिदास हिमालयाला 'खरा महात्मा' म्हणून संबोधतो. ज्याप्रमाणे महात्मा अन्यायाशी, अज्ञानाशी झगडतो व तेज, ज्ञान यांची कास धरतो, त्याचप्रमाणे हिमालयही अंधःकाराशी लढा देत कायम स्थिर उभा राहतो. याचे वर्णन करणारा श्लोक म्हणजे -

दिवाकराद रक्षति यो गुहासु
लीनं दिवा भीतमिवान्धकारम् ।
क्षुद्रेऽपि नूनं शरणं प्रपन्ने
ममत्वमुचैः शिरसां सतीव ।।

- (कुमारसंभव, पहिला सर्ग, श्लोक क्र. १२)

जेव्हा शिव-पार्वतीच्या मीलनासाठी वसंत ऋतू कैलास पर्वतावर प्रकट होतो, तेव्हा वृक्ष-वेलीदेखील रसिक होतात व त्यांनाही अंकूर फुटू लागतात. भुंगेदेखील मदनाच्या बाणांनी विद्ध होऊन आम्रतरूवरील मोहराकडे आपोआप ओढ घेतात. अशाप्रकारे जेव्हा वसंत येतो, तेव्हा वनदेवीच जणू शृंगाराने नटली आहे, असे कालिदास म्हणतो. या वसंताचा परिणाम माणसांवरच नव्हे, तर मनुष्येतर प्राण्यांवरही होतो, हे सांगताना कालिदास क्रीडा करणाऱ्या हरिणीचा उल्लेख करतो.

प्रवातनीलोत्पलनिर्विशेषम्
अधीर विप्रेक्षितमायताक्ष्या ।
तया गृहीतं नु मृगाङ्गनाभ्यम्
ततो गृहीतं नु मृगाङ्गनाभिः ।।

- (कुमारसंभव, पहिला सर्ग, श्लोक क्र. ४७)

हरिणी आपल्या प्रियकरांना इशाऱ्यानेच बोलवत व ते भेटल्यावर त्यांच्या सहवासात रंगून जात. माणसांप्रमाणेच मनुष्येतर प्राण्यांमध्येही 'रती' हा स्थायीभाव सारखाच आढळून येतो. मदनाच्या

आगमनानंतर केवळ मनुष्यच नव्हे, तर भ्रमरीसह मधुप्राशन करणारा भ्रमर, तसेच हरिणींशी पाठशिवणीचा खेळ खेळणारा हरिणही कामवासनेने पीडित झाला आहे. पक्षीदेखील प्रेमाने एकमेकांना घास भरवत आहेत, तसेच विरहाने व्याकुळ झालेल्या व थरथरणाऱ्या लता आपल्या शाखा उंचावून तरूंना घट्ट मिठ्या मारतात, असे शृंगारिक वर्णन करत कालिदास मानव व निसर्ग यांमध्ये आढळणाऱ्या प्रेमभावनांमधील साम्य दाखवतो.

कालिदासाच्या अतिशय प्रसिद्ध नाटकात, म्हणजेच 'अभिज्ञानशाकुन्तलम्' मध्ये कालिदास निसर्गाला जणू एक जिवंत पात्र म्हणून उभं करतो.

पातुं न प्रथमं व्यवस्यति जलं युष्मास्वपीतेषु या,
नादत्ते प्रियमण्डनापि भवतां स्नेहेन या पल्लवम् ।
आद्ये वः कुसुमप्रसूतिसमये यस्या भवत्युत्सवः
सेयं याति शकुन्तला पतिगृहं सर्वैरनुज्ञायताम् ।।

- (अभिज्ञानशाकुन्तलम्, चौथा अंक, श्लोक क्र. ३)

म्हणजेच, 'शकुन्तला' जी या नाटकाची नायिका, किंबहुना निसर्गकन्या अथवा आश्रमकन्या आहे, ती निसर्गाच्या सहवासात वाढलेली आहे. दागिने प्रिय असूनही, केवळ झाडाची पालवी तोडली जाऊ नये, म्हणून निरलंकृत राहते. ती आश्रमातील प्राणिमात्रांना सग्या-सोयऱ्यांप्रमाणे केवळ मानते असे नव्हे, तर त्यांनी पाणी प्यायल्याशिवाय ती पाण्याला स्पर्शही करत नाही. आश्रमातील झाडांवर कळ्या उमलू लागल्या की तिला उत्सव साजरा करावासा वाटतो. येथे कालिदास 'कुसुमप्रसूतिसमय' अशी शब्दयोजना करतो. सर्वसाधारणपणे 'प्रसूतिसमय' असा शब्दप्रयोग आपण माणसांबाबत करतो व येथे कुसुमांबाबत हा शब्द वापरून जणू तो फुलांना मनुष्यजातीचाच एक भाग मानतो आणि म्हणूनच शकुन्तला पतिगृही जाताना काश्यपमुनी, अर्थात् शकुन्तलेचे पिता, वनातील पशुपक्ष्यांची, झाडांची, फुलांची अनुमती मागतात. यावेळी शकुन्तलेच्या सख्या व आश्रमातील इतर लोकच नव्हे, तर संपूर्ण तपोवनच जणू शोकसागरात डुबून गेलं होतं. याचं वर्णन करताना कालिदास म्हणतो -

उद्गलितदर्भकवला मृगाः परित्यक्तनर्तना मयूराः ।
अपसृतपाण्डुपत्रा मुञ्चन्त्यश्रूणीव लताः ।।

- (अभिज्ञानशाकुन्तलम्, चौथा अंक, श्लोक क्र. ४)

गोंडस हरिणपाडसांनी मुखातील दर्भाच्या घासांचा त्याग केला आहे, मयुरांनी नृत्य करणे थांबवले आहे, तर वेली आपल्या वाळलेल्या पानांच्या रूपाने जणू अश्रू ढाळत आहेत, असे वर्णन कालिदास करतो. येथे निसर्गाच्या भावभावना कालिदासाने समर्पक शब्दांत व्यक्त केल्या आहेत. तसेच, शकुन्तलेचेही त्यांच्यावरील प्रेम प्रत्येक शब्दातून व क्रियेतून प्रकट होते. शकुन्तलेने तिच्या सख्या असणाऱ्या वेलींचे नामकरण केलेले दिसते व प्रत्येक वेलीचा ती जातीने निरोप घेते, त्यांना आलिंगन देते आणि आश्रम सोडून जाताना त्या वेलींना इतर सख्यांच्या हातात सुपूर्त करते. तसेच आपली प्रिय हरिणी प्रसूत झाल्यावर मला निरोप पाठवा, हे आपल्या पित्याला ती आठवणीने सांगते. शकुन्तलेचा आपल्या आश्रमातील प्राण्यांवर केवढा जीव होता, याचे वर्णन करणारा आणखी एक श्लोक आढळतो -

यस्य त्वया व्रणविरोपणमिङ्गुदीनां
तैलं न्यषिच्यत मुखे कुशसूचिविद्धे ।
श्यामाकमुष्टि परिवार्धितको जहाति,
सोऽयं न पुत्रकृतकः पदवीं मृगस्ते ।।

- (अभिज्ञानशाकुन्तलम्, चौथा अंक, श्लोक क्र. ५)

या श्लोकात, शकुन्तलेने लहानपणी त्या पाडसाला तोंडाला झालेल्या जखमांवर इंगुदीचे तेल लावल्याचे वर्णन कालिदास करतो.

अशाप्रकारे संस्कृत साहित्यातील निसर्गवर्णने ही आपल्याला निसर्गाचे खूप जवळून दर्शन घडवतात; पण आज, आपल्या सभोवती असणारा निसर्ग व साहित्यातील निसर्ग यात मोठी तफावत जाणवते. किंबहुना आज माणसाची निसर्गाशी मानसिक जवळीक होऊ शकत नाही. तंत्रज्ञानाच्या विकासामुळे माणूस निसर्गापासून दूर गेला आहे असे वाटते. सर्वसाधारणपणे 'निसर्ग आणि मी' अशी माणसाची प्रवृत्ती, माणूस व निसर्ग वेगळा आहे असे दर्शवते. परंतु ज्या गोष्टीपासून आपला जन्म झाला, त्या गोष्टीपासून आपण वेगळे कसे असू, किंवा आपली आपल्या जन्मदात्याशी तुलना कशी होईल ? त्यापेक्षा निसर्ग म्हणजेच मी असे म्हटल्यास जी एकरूपता अनुभवास येते, त्यापासूनच निसर्गाबद्दलच्या **प्रेमाची** सुरुवात होते. आदान-प्रदान संस्कृतीचा जागर करणाऱ्या आपणाला निसर्ग भरभरून सर्व काही **प्रदान** करत असतो. फळं, फुलं, पाणी, प्रकाश, उब, प्राणवायू, हवा, गारवा अशी दाने स्वीकारताना -

देणाऱ्याचे हात हजारो, दुबळी माझी झोळी ।

अशी आपली अवस्था झाली नाही तरच नवल ! परंतु त्या बदल्यात आपण निसर्गाला प्रदूषित हवा, विषारी वायु, जंगलतोड, काँक्रिटचे वर्चस्व बहाल करतो. ही माणसाने दर्शवलेली कृतज्ञता की कृतघ्नता याचा विचार माणसाने करायला हवा. निसर्ग व मानव हे वेगळे नाहीतच असा विचार करता निसर्गाचा सर्वनाश म्हणजेच माझा सर्वनाश असे तर्कशुद्ध उत्तर माणसाचे डोळे उघडेल अशी आशा वाटते. प्रदीर्घ निर्मिती-प्रक्रियेपेक्षा, नाश करणे क्षणैक असते. नाश, विध्वंस यात मिळणाऱ्या क्षणिक आनंदापेक्षा, बुद्धिमान अशा माणसाने श्रेयस्कर मार्ग स्वीकारावा व अन्ततो गत्वा हाच मार्ग मानवाचे कल्याण करणारा आहे.

श्रेयश्च प्रेयश्च उभौ विचिन्त्य,
श्रेयो हि धीमान् अभिप्रेयसो वृणीते ।

Interlinking of Rivers Project

Biswajit Deb and Utsav Vatsyayan
S. Y. B. A. (Economics)

"Of all the social and natural crises we face, water crisis lies at the heart of our survival."

- Kochiro Matsuura
Director General of UNESCO

As far back as human history goes, nature has been a source of inspiration for us. Further, it has been the provider of every resource. Every aspect of life is related to it and cannot be imagined without it. With the development of civilisation, however, humans started exploiting nature for fulfilling their requirements without worrying about its preservation.

In economics we aim at gaining maximum utility. But the term 'utility' is to be understood properly. It is the best possible deal we can get at the most reasonable price. For example, when a boy eats, say, five mangoes, his appetite is satisfied and he feels good. Now if he is forced to have more than five mangoes, it will affect his health adversely. Here we can see that though the number of mangoes increases the boy is not happy, because eating more mangoes is not doing him any good. For the boy the best deal is having only five mangoes, or, to state it differently, five mangoes give him maximum utility. Similarly human beings should focus on maximum utility from nature and not on maximum exploitation of nature. But the approach we have had towards nature has been one, precisely, of exploitation, and this has led to many grave problems. One of them is the problem of availability of fresh water. Fresh water supply is dwindling at an alarming rate even as the demand for water grows manifold. India is no exception to this.

As a matter of fact, in India the problem related to water is like a double-edged sword. Often, while we see droughts in some parts of the country, ironically, there are floods in some other parts at the same time. This has initiated a debate on better utilisation of India's water resources. To handle its water woes the Ministry of Water Resources has proposed a mega project of interlinking of rivers. We chose to write about it here because it has connection with economics as well as nature. The project in question proposes to alter the course of nature. This can turn into one of our worst ecological nightmares—or it can lead us to prosperity we only dream of.

What is ILR ?

To understand what 'Interlinking of Rivers' exactly is, some background is necessary. The great eastern India famine of 1966-67 led the then Irrigation Minister, Dr. K. L. Rao, to present a back-of-the-envelope proposal for a Ganga-Cauvery Link from a point below Patna. This was put aside as

unviable on account of the large energy requirements to lift water across high ridges. There followed a scheme forward in 1977 by an aviator, Captain Dastur, for a lateral Himalayan canal from Ravi to the Brahmaputra along a constant 400-metre contour, interconnected with a Garland Canal girdling peninsular India. This was rejected as technologically and economically unfeasible and environmentally unsound. However, the idea of moving water from surplus areas to deficit areas survived.

The Central Water Commission, the technical arm of what is now India's Ministry of Water Resources, presented a more viable National Water Perspective in 1980. The papers of this concept were then handed over to a newly created National Water Development Agency (NWDA) in 1982, with a mandate to develop it further. The NWDA took a 40-year perspective of demographic changes, urbanisation, industrialisation and other development parameters to make a long-range forecast of requirements, matching this with water balance studies in over 200 basins and sub-basins, potential diversion points and storage sites. Having mapped the likely deficit and surplus sub-basins, it listed 30 promising inter-basin links.

Of the 30 inter-basin water transfer projects proposed, nine are independent links from surplus basins to deficit ones. The remaining 21 are more complex, interdependent links that in combination make up a few major inter-basin transfer systems. Of the total, 16 are peninsular links and 14 Himalayan. If all the 30 links were taken up, NWDA estimated that the task could be completed within 35 years of the commencement of construction at a national cost of Rs. 5,60,000 crores at 2002 prices.

The Merits of the Project

As proposed by the government, the benefits of such a scheme are obvious—it would add 35-37 million hectares of irrigated land, generate 34,000 megawatts of electricity, increase navigational efficiency and help in controlling floods and eliminating chances of drought.

Is it Feasible and Desirable?

The important question that lies ahead of us is whether our country is ready and able to handle such a project. Is it economically and environmentally acceptable? Though votaries of the river-linking project say channelling the surplus water to underfed areas will solve perennial problem of floods and droughts and bring a boom in employment, there is also another side to the coin that needs to be taken into account. Water management experts have expressed doubts about this ambitious project. At the end of a workshop on 'Frontline Issues in Water and Land Management and Policy', held under the auspices of the Colombo-based International Water Management Institute (IWMI), Tushaar Shah, head of the IWMI-Tata Water Policy Programme, expressed his concerns over the

issue. According to him his team was yet to go into the cost-benefit ratio and the pros and cons, but on the face of it, the project did not appear practical. Besides entailing huge costs—over $ 120 billion, which would mean that each year for the next 25 years, at least one percent of the GDP would have to be spent on the project—it would need a long gestation period of about 40 years by which time the priorities and requirements of the country would have changed.

The government on the other hand is counting on its programme's success citing examples of Periyar which was diverted through the high ranges of Kerala in order to replenish the Vaigai river in Tamil Nadu, the Indira Gandhi Nahar or Rajasthan canal, and the Sardar Sarovar Project which carries Narmada waters across seven basins to the arid areas of North Gujarat, Saurashtra and Kutch. But the government is ignoring the fact that these projects have proved to be more of a burden than assets. They have eaten more than what they have provided. So there is a need to think seriously and pragmatically where such a huge amount of money is at stake, because once you have stepped forward there can be no returning back and we cannot just rely upon NRIs and foreign financial institutions.

Besides the economic problems, there is also the fear that the ILR project could turn into an ecological nightmare. A number of leading environmentalists are of the opinion that the project could be disastrous in terms of its impact on the ecosystems of the country. One of India's best-known environmentalists, Dr. Vandana Shiva, opines that that the scheme has the potential to cause large and irreparable damage on a scale that is unimaginable. There would be loss of biodiversity, reduction in downstream flows, damage to fisheries and wildlife, displacement of people, conflict over water sharing and pressure created on land by cubic tones of water that might cause seismic tremors. Studies by Dr. Shiva's institute, Navadaya, reveal that a dam constructed at the Sharada-Yamuna link in Haryana is going to create a load of 500 billion tonnes on the uphill side, making the surface tremor-prone due to this load. She adds that all rivers change their course every 70 to 100 years. This is a natural phenomenon that cannot be altered. Even if they were linked today after a few decades the entire project would be in vain.

Studies reveal that the flora and fauna will also be adversely affected by this project. For example, the Panna Tiger National Park in Madhya Pradesh that falls in the vicinity of the linking of Ken and Betwa rivers is going to suffer major damages. Over 50 square kilometres of land, which is a habitat to many endangered species that fall under the wildlife protection act 1972, will get submerged. Add to this the construction of the dam, which will result in large deforestation in an area where the entry of noise-polluting diesel vehicles is banned. The construction that will take over 10 years will virtually kill the ecology in the area. Similarly in Uttar Pradesh, the famed Jim Corbett National Park that falls under the Shadra-Sahayak

Canal Link will bear irreparable losses with the submergence of the elephant reserve area. Environmentalists say that connecting the peninsular rivers in the Himalayan region would not just alter the natural drainage but the 40,000-km long inland waterways would cause massive human displacement.

Government's Stand

Dam sites are invariably in the hills, most often in the remote and sequestered areas that have remained backward and isolated because of their inaccessibility. This very inaccessibility often compels the communities living there to lead uncertain lives on ecologically unsound subsistence farming. The access road and other infrastructure necessary to build a dam and appurtenant works would at once ensure connectivity and market access and release these communities from insecurities, as they can then switch to more productive and ecologically friendly occupations. Horticulture, herb cultivation, vegetable gardening and a new pattern of hill agriculture and livestock rearing would become possible, with grain being supplied from the plains. Such area development could absorb project-affected persons *in situ* in gainful employment without social trauma. Eco-tourism, pisciculture and afforestation can minimise the side effects of this project, besides offering additional avenues of employment.

Conclusion

This project needs a thorough and microscopic study. We cannot ignore the economic and environmental hazards of ILR. Various proposals that promise to curtail these side effects look good on paper, but past experiences with similar projects tell a different story altogether. Besides, we also need to consider our foreign affairs. India's water system is interdependent on those of Nepal, Bhutan and Bangladesh. We would like to say here that the government should not act hastily on this project, as it still needs to be assessed more critically for its cost, implementation and impacts. What it should do to alleviate the country's water problems while the debate is on is, it should increase micro and mini means of moisture conservation through rainwater and rooftop harvesting, groundwater recharge, de-silting of water bodies, watershed management and other more acceptable means.

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Nature and Political Science

Pradnya S. Khade
S. Y. B. A. (Political Science)

The link between man and nature is an important issue in politics. In the last 58 years a growing concern about the environment at domestic and international levels has made it necessary for any government to take cognisance of this issue. Though one could say that there is no direct connection between politics and environment or nature per say, it is undeniable that any talk on protection and preservation of nature or environment must necessarily bring policy making into picture.

First we shall look at the current international situation with regard to environment. We can see that almost all countries of the world are making conscious efforts to save their environment. But, the most influential work has been done by the European Federation of Green Parties.

The European Green Party, founded at the 4th congress of the European Federation of Green Parties in Rome, has 32 member parties from Europe and 6 observer parties. The party works for the combined interests of its members and supports smaller Green parties in order to strengthen the Green political movement as a whole.

The German Greens are generally regarded as the 'Mother' of all Green parties, although they are not the oldest or the first Green party to enter the national Parliament. Their significance comes from being the first Green Party to have a strong presence in the legislature of a large nation. The big break came in 1983, when Die Grunen attracted nearly a million votes and gained 28 seats out of 497 in the federal Parliament.

The Green movement as an electoral force is young. The first ecological and alternative political groups emerged in the 1960's. The very first ecology party in Europe emerged in Britain in 1973. In Belgium the French speaking Ecolo was formed in 1980. In Italy, the Greens entered the Parliament in 1987.

In 1979 the Swiss Green Party was the first to have a Green elected to a national Parliament in Europe. Little by little, Greens started being represented in the parliaments of Austria, Belgium, Finland, Georgia, Sweden, Germany, Ireland, Italy, Portugal and Slovakia. Altogether, the national Green parliamentarians and Green Members of the European Parliament number over 300.

The Greens first emerged as a significant political force in Europe. However, Green Parties have played an important role and continue to gain strength elsewhere also. Most recently, the Taiwanese Greens made significant contribution to the Green movement in Asia by winning the continent's first Green national parliamentary seat. In Tasmania, the Greens enjoy a balance of power position in the state parliament. In the US

presidential campaign for November 1996, the candidacy of Ralph Nader for the Greens put them on the US political map.

Closer links with non-European Greens are forged through expanded co-operation and electronic communication. The Federation will assume particular responsibility to help these contacts.

The UNO has also made an Environment programme (UNEP). The World Summit on Sustainable Development (WSSD) opens at the Sandton Convention Centre in South Africa. UNEP's Executive Director went on record saying, "New scientific evidence of global environment change necessitated quantum increase in efforts." He characterised WSSD as a summit of implementation, accountability and partnership.

The World has come a step ahead to protect the environment after signing the Kyoto Protocol. About 180 countries became signatories of this document at Kyoto, Japan in December 1997. The Kyoto Protocol, or Kyoto Protocol to the United Nations Framework Convention on climate change (UNFCCC), is an international treaty on global warming. It is actually an amendment to the UNFCCC. Countries which ratify this protocol commit to reduce their emissions of carbon dioxide and five other greenhouse gases, or engage in emissions trading if they maintain or increase emission of these gases.

Even when we study different political thoughts, we find that almost all political thinkers, whether they belong to the ancient times, the medieval times or the modern times, and whether they are Western or Indian/ Oriental, have given the utmost importance to nature in their writings. All political, social, economic and philosophical writings, somewhere or other, exemplify our relationship with and deeprootedness in nature.

Let us now see what steps India, or the Indian government, has taken to protect the environment. In our country there has been a tradition of linking nature with the political and social systems, and the 'lived' realities have been a part of the Indian traditional political thinking, which can be seen in the writings of Gandhian ideologies, like those of Vinoba Bhave and Jay Prakash Narayan.

The Government of India has made some good policies to protect our precious and prosperous environment.

A. Constitutional Safeguards:

(1) 42nd Amendment, Article 48(A) (Directive Principles): The state shall endeavour to protect and improve the environment and safeguard the forests and wildlife of the country.

(2) Article 51(A) (Fundamental Duties): It imposes a responsibility on every citizen to protect and improve the natural environment, including forests, lakes and rivers, and to have compassion for living creatures.

Further, the Parliament, under Article 253, has enacted the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection)

Act 1986, the Water (Prevention and Control of Pollution) Act, the Wildlife (Protection) Act 1972, the Forest (Conservation) Act 1980, and other Government of India Acts.

B. Government Policies:

(1) India has set up a committee on Human Environment.

(2) The National Committee on Environment Planning and Co-ordination was established in February 1972.

(3) The 9th Five Year Plan (1997-02) gave priority to the programme aimed at spreading environmental education and awareness.

(4) There is the concept of Joint Forest Management between the government and local communities. It can be said that in the planning process also the environmental issues are important.

(5) Government Schemes: There are different government schemes for afforestation, for which funds are provided by the central government to all states. The 'Action Plan' for afforestation recommended by the Central Government has three stages:

   i. The Public will have no access to the lands covered by forests.

   ii. Efforts will be made by the government with the assistance of NGO'S to re-establish forests.

   iii. The government should invite public participation in its programmes of afforestation.

In conclusion we can say that all aspects of human life are directly or indirectly related to nature. Here, as a student of Political Science, I have made an effort to show the relation between nature and Political Science. It is evident that only when nature functions smoothly, human life can be happy. There can be no meaningful talk of politics in the absence of a stable natural environment. Therefore we should take care of nature and thereby ensure the safety of humankind too.

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Nature and Literature : An Endless Saga

Kunal Ray
F. Y. B. A. (English)

For any self-professed lover of literature, the very mention of the word 'nature' leads to a period of unabashed reverie and a rush in their adrenaline. I am no exception in this regard. As someone who has grown up on a staple diet of Wordsworth, Byron, Shelley, Keats, etc., the influence of nature on my psyche has jacked up to dizzying heights over the years. In literature, nature is reflected in two forms:

1) Pictorial
2) Ongoing processes

While the former betokens nature as "a collection of finished products" and sings its praises, the latter is a symbolic representation of the explicit dynamism of life, a matter that has always kept debate of any kind at bay. Anything that we bump into in our daily lived lives has a kind of process behind it and the poets have tried to capture these processes in their poetry.

Nature is frequently referred to as the storehouse of images that effectively represent human emotions. Whatsoever the mind experiences, it can be explained best through the forces of nature. It is the language of the mind and a bridge that links the mind with the heart. It is a means to reach an end. Feelings like ecstasy, grief, and depression can be best expressed employing the forces of nature. To bolster my claim, I would like to cite the following lines by Wordsworth, which give vent to his joy at heart on seeing a rainbow:

> My heart leaps up when I behold
> A rainbow in the sky.

Similarly, Keats in his 'Ode to Nightingale' confirms his escapist attitude by yearning to escape from the human world of misery and agony and implant himself in the nightingale's world, wherein the serene bird sings profusely, completely unaware of the incendiary circumstances in the human world. He says:

> Away! Away! for I will fly to thee,
> Not charioted by Bacchus
> And his pards,
> But on the viewless wings of poesy.

We also come across an engrossing use of natural objects in plays by Shakespeare. The best example could be 'The Tempest' wherein the title itself is suggestive of the mental flux that the primary characters in the play go through.

Nature also exerts a determining force in human life. Everyone counts on nature. All of us bear an inner pining for beauty and this passion is

satiated by the objects of nature. We see people increasingly bringing nature in their abodes in the form of bonsai, money plants, etc. which not only soothe their heart but also their health.

Nature also morphs into a medium for an artist to showcase her or his prowess. The Romantic poets like Wordsworth, Keats, et. al. wanted to strike a chord of harmony with nature and restore the dwindling balance, because they regarded it as a centrifugal force in an individual's life. But this charge has been widely refuted in Victorian poetry. Whereas the Romantic poets were unfathomable in spirit while waxing eloquent on the glories and bounty of nature, the Victorian poets lost no time voicing their view that nature was an impersonal, indifferent force, absolutely harbouring no sympathy for mankind. But this is no reason to believe that all modern poets are averse to nature. Dylan Thomas is a case in instance. He has a reverent attitude towards nature and finds his sermons in inanimate objects like stones. His 'Fern Hill' is an all-time epic.

Nature has also been acting as a guide for ethical life since time immemorial. The various objects of nature set footprints for human behaviour. They instil a sense of unity, symbiosis, discipline and belongingness in us. As Shelley points out:

> A sensitive plant in a garden grew,
> And the young winds fed it with silver dew.

Literature is also, at the same time, deluged with examples that bring to the fore the fact that in spite of its philanthropist kind of makeup, one should not be excessively demanding from nature, because greed always schemes its own downfall.

Some will be surprised to know that through nature some poets have also tried to reflect their sense of nationalism. They have done this chiefly by highlighting their native landscapes, and by speaking of their pet birds, fruits, plants and the like. American poets like Robert Frost did it consciously and cautiously. We also find an engaging pictorial description of Irish landscapes in Keats's poetry and the intoxicating poems by Rabindranath Tagore also exemplify this same way of writing about nature.

Those who worship natural beauty are in a way highlighting the environmental problems, too. Urbanisation has spread its wings and soared unprecedented heights. In this age, literature has become a sanctuary of nature. It has preserved nature in all its hues and to reap off its dividends, do I need to spare a word preaching what you require to do?

The Nature Within

Chinmay Aradhye
S. Y. B. A. (Psychology)

Human beings are arguably the most interesting creation of nature. What sets us apart from other creatures on Earth is our brain. Psychology is the study of human beings through the study of their brain. The working of our brain is completely controlled by nature, and hence, in everything that we do, we follow the unwritten laws of nature.

Ever since humans evolved on this planet, they have done what nature wants them to do. Each and everything, from survival to self-actualisation, is programmed into us by nature, like a command programmed into a computer. Our actions, reactions, expressions, emotions, everything that we experience or do, are all a part of this programme. And psychology is the study that endeavours to decode the unwritten messages that constitute this programme in our brain. Psychology explains why and how human behaviour is based in nature.

Like all other animals, humans have evolved over ages. We are a species of primates called Homo sapiens, a hairless ape that has learned to walk on two limbs and has a clever, advanced brain. But many people find it difficult to accept that humans are still, biologically, animals. The truth is, even although we live in an advanced, technological world today, we are still, as much as our ancestors ten thousand years ago were, dominated by the rules prescribed to us by nature.

Let us find out about the reasons underlying the most common human expressions and actions. Let us start with laughter. Laughing is a way of exposing one's teeth, which is also seen in apes as an attacking gesture. An ape, when suddenly threatened, displays its sharp teeth to show that it can attack with them. Laughing is a human reaction to surprises. This is how most jokes work: something surprising happens in the end, the brain gets a shock and triggers a big smile or laughter. This also happens with a person who was about to be hit by a vehicle on the road and narrowly escaped. He smiles and says, "Phew, that was close!" Even when the brain is surprised by negative shocks, such as death of a close person, disbelief is expressed in the form of laughter; when reality hits, laughter turns to crying.

Smiling, on the other hand, is a type of submission signal, because it exposes only the front teeth, which are not as sharp as the canines. Smiling is a way of saying "Look, I am harmless". Hence, dominating personalities are observed to smile less when with people they consider as inferior, as smiling may give the signal of submission.

Another rule of nature, which is also observed in other animals, is that humans have their personal spaces and territories. When a stranger enters your territory, you react, quite unknowingly, by hiding your

emotions, avoiding eye contact with the person or even folding your arms, which is a defensive gesture. This can be seen in places such as elevators where there is interference in each other's personal spaces. Like animals mark their territories, humans too display their possessions by sticking pictures on cupboards, bikes, etc. This is the main reason behind children throwing their clothes on bed or keeping stuff on their tables, etc. These things come to humans naturally; we just express them in different ways than other animals do.

Yet another display of nature's unseen power over humans is in human courtship. In human courtship, sexiness is expressed by highlighting the gender differences. What seems sexy for a man in a woman is how she is different from him, and vice versa. The muscle toning in her body is not strong and hence he feels he can dominate. Men's bodies are made for hunting and killing and women's bodies for bearing and rearing babies. What a man sees in a woman, when he thinks she is beautiful, is her ability to reproduce his genes; and what a woman thinks when she looks at a man is, how well he can take care of her and her baby by using his strength. The difference in the physical structure in men and women is what attracts them to each other. Men's faces are built to protect their eyes and face from attacks of wild animals; women on the other hand have baby-like faces, which makes them vulnerable to external attacks. Research shows that men are attracted to women who look more like babies, which stimulates a feeling of protecting them.

This explains why, contradictory to common belief, only 10% of sex lies between our legs, 90% of it lies between our ears, i.e. within our brains. Physical urge is just a representation of mental stimulation, which follows definite patterns of nature.

Emotions expressed or felt by humans are a way of reducing stress or maintaining body mechanism naturally. Crying releases certain chemical enzymes that help our body regain strength after a negative event. Laughing produces chemicals that reduce the stress and tension of the muscles. Anger makes blood rush through the veins, giving extra power to the muscles. That is why people do violent things in a fit of rage. The root of anger is always fear—fear of loosing something, fear of embarrassment, and so on. Fear causes adrenalin to rush in the blood stream, which stimulates the body to react to dangers, either by fighting them or by running away from them. This characteristic is also exhibited by other, wild animals when they feel threatened.

The preceding makes it clear that whatever we feel and experience in this world is because of what happens inside us, which is only triggered by external stimuli. Psychology focuses on exploring the power within rather than the power from the material things outside.

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भारतीय परंपरेच्या दृष्टिकोनातून मानवाचा निसर्गाशी संबंध

कोमल मंत्री, तृतीय वर्ष साहित्य, सौरभ रासकर, द्वितीय वर्ष साहित्य
(इतिहास)

भारतीय संस्कृती म्हणजे हिंदू संस्कृती होय. (इथे 'हिंदू' या शब्दाचा अर्थ 'समूहाची संस्कृती' या अर्थाने घ्यावा; हिंदू 'धर्म' म्हणून घेऊ नये.) 'हिंदू' हा शब्दच मुळी 'इंडस व्हॅली कल्चर' या शब्दावरून आलेला आहे. 'इंडस' म्हणजे 'सिंधू' आणि 'सिंधू' या शब्दाचा अपभ्रंश हिंदू असा काळाच्या ओघात झाला. या सिंधू नदीच्या खोऱ्यात वाढलेली संस्कृती म्हणजेच हिंदू संस्कृती.

या आपल्या भारतीय संस्कृतीची सुरुवातच निसर्गापासून झाली आहे. निसर्गातील पंचमहाभूते ही जगाचा व्याप चालविण्यासाठी कारणीभूत आहेत, हे फार पूर्वीपासूनच आपल्या परंपरेने ओळखले आहे. म्हणूनच पर्यावरणाची पूजा करून, त्याला प्रसन्न करून जीवन जगणे हीच भारतीय परंपरा आहे.

या पंचमहाभूतांमध्ये पृथ्वी, आप, तेज, वायू, आकाश यांचा समावेश होतो. या निसर्गाच्या विविध अंगांमध्ये श्रद्धा ठेवून, त्यांना देवत्व देऊन, त्यांची पूजा-अर्चा केली जाऊ लागली. वाङ्मयातील विविध पौराणिक कथांमध्ये त्यांचा उल्लेख येऊ लागला. निसर्ग व मानव या संबंधांना भारतीय परंपरेने आपल्या विविध भाषेतील वाङ्मयाव्दारे (वेद : ऋग्वेद, यजुर्वेद, अथर्ववेद व सामवेद या संहिता तसेच ब्राम्हणग्रंथ, अरण्यके, उपनिषदे, वेदांगे) दृढ केलेले आहे. पृथ्वीला भूमातेच्या स्वरूपात, आप (जल) ची पूजा, कलशपूजेच्या तसेच नदी व समुद्राला अर्घ्य देऊन, तेज (अग्नि) ची यज्ञाच्या वेळी हवी देऊन, वायूला पवनदेवतेचे रूप देऊन, तर अवकाशामध्ये घंटानाद करून, शंख वाजवून आकाशाची पूजा होते.

निसर्गातील शक्तीची पूजा म्हणजे निसर्गपूजा. मनुष्य अडाणी, साधाभोळा किंवा सुसंस्कृत कसाही असो, त्याच्या जीवनात निसर्गाचे महत्त्वाचे स्थान असते. किंबहुना मनुष्याचे सर्व जीवन बहुतांशी निसर्गाच्या चक्रानुसार चालते. माणसाला प्रत्येक नैसर्गिक घटनेविषयी कुतुहल वाटते. हे कुतुहल अनेक लोककथा व पुराणकथा यातूनही स्पष्ट दिसते. त्यात निसर्गातील दृश्ये व घटना यांना कधी व्यक्तिरूप दिलेले असते, तर कधी त्यांचा संबंध देवांशी जोडलेला असतो. निसर्गाच्या घडामोडीच्या मागे जी अद्भुत शक्ती आहे, तिचा मनुष्याच्या जीवनावरही पुष्कळ प्रभाव पडतो. हे दिसून आल्यानंतर तो त्या शक्तीची-म्हणजे निसर्गाची पूजा करू लागला. निसर्गपूजा फार प्राचीनकाळी सुरू झाली असून बहुतेक सर्व धर्मांत तिचा अंतर्भाव आहे, असा उल्लेख आहे.

पाऊस, भरती-ओहोटी, भूकंप इ. निसर्गातील घटना व हालचाली नदीचा प्रवाह, वारा इ. पदार्थांची गती आणि मनुष्याचे चलनवलन या सर्व गोष्टी एकाच प्रकारच्या प्रेरकशक्तीमुळे-म्हणजे प्राणशक्तीमुळे होतात, अशी प्राचीन मानवाची कल्पना होती. ज्या ठिकाणी अफाट व अद्भुत रूप दिसून आले, त्या ठिकाणी निसर्गपूजा भक्तिपूर्वक केली जाऊ लागली.

प्रारंभी मनुष्य हा पशू, पक्षी, वस्तू अशा भिन्न रूपात निसर्गाची पूजा करीत असे. कालांतराने या व्यक्त रूपांहून भिन्न अशा चिन्मय देवतांची कल्पना उगम पावली. मनुष्याने स्वत:च्या देहात आत्मतत्त्वाची कल्पना केली, त्याचप्रमाणे भोवतालच्या वस्तूंतही ते आहे, असे मानले. निसर्गातील

विलक्षण घटनांवरून त्याने त्याच्या भव्य व दिव्य रूपाची कल्पना केली आणि अशा शक्तीला प्रसन्न करण्यासाठी प्रार्थना, समर्पण इत्यादी उपाय त्याने शोधून काढले. कालांतराने या उपायांना महत्त्व प्राप्त झाले.

ऋग्वेदात पर्जन्याला देवतेचे स्थान आहे; तसेच त्यातील काही सूक्तांत पर्जन्याची प्रशंसा केलेली आहे. पर्जन्याचा अर्थ इथे वर्षाकालीन मेघ असा केलेला असून, त्याच स्वरूपात त्याचे वर्णन केलेले आहे. हाच मेघ दररोज खालून वर जातो आणि वृष्टी करून पृथ्वीला तृप्त करतो, असे म्हटलेले आहे. त्याला मोठ्याने हंबरणाऱ्या वृषभाची उपमा दिली आहे. तो द्यूचा पुत्र असून बलवान, गर्जना करणारा, उदकवर्षाव करणारा व वनस्पतीमध्ये जलरूप गर्भ घालणारा आहे. तो औषधींचे संवर्धन करतो, पाण्याची सुबत्ता करतो आणि जगावर सत्ता चालवतो. तो स्थावर-जंगम सृष्टीचा आत्मा आहे. सुख देण्याबद्दल, औषधी फलयुक्त करण्याबद्दल, अन्न देण्याबद्दल आणि पृथ्वी ज़लाने भरून टाकण्याबद्दल त्याची प्रार्थना करण्यात आली आहे.

पर्जन्याविषयीचे ऋग्वेदातील एक सूक्त :

पर्जन्याय प्र गायत दिवस्पुत्राच मीळ्हुजे ।
स नो यवसमिच्छतु ।।
यो गर्भयोषधीनां गवां कृणोत्यर्वताम् ।
पर्जन्यः पुरुषीणाम् ।।
तस्मा इदास्ये हविर्जुहोता मधुमत्तमम् ।
इळां नः संयतं करत् ।।

याचाच अर्थ असा :

आकाशाचा पुत्र आणि जलाचा वर्षाव करणारा जो पर्जन्य, त्याच्यासाठी स्तुतिगायन करा. आम्हाला धनधान्य देण्याची त्याची इच्छा होवो. या पर्जन्यामुळे औषधी वनस्पतींमध्ये, गायीमध्ये, घोड्यांमध्ये आणि स्त्रियांमध्ये गर्भधारणा होवो. म्हणून हे ऋषिजनो, त्याच्या प्रीत्यर्थ्य अग्निमुखामध्ये हा अत्यंत मधुर असा हविर्भाग अर्पण करा. तोच आमची सर्वतोपरी समृद्धी घडवून आणील.

पर्जन्य या नावाची व्युत्पत्ती अनिश्चित आहे; पण त्याच्या स्वभाववैशिष्ट्यांवरून थिओंडस बेनेफ या पंडिताने लिथुआनिअन गर्जनदेवता पर्कुनस याच्याशी त्याचा संबंध जोडला आहे.

भारतातील कित्येक पर्वतांना निरनिराळ्या कारणांमुळे पूजत्व प्राप्त झाले आहे. काही पर्वतांवर देवांचे वास्तव्य असते, तर काही पर्वतांवर थोर मुनी व साधू वास करतात. काही पर्वतांवर देवतांची मंदिरे असतात, तर काही पर्वतांवर नद्यांची उगमस्थाने असतात. पुराणे, काव्ये आणि लोककथा यात अनेक पर्वतांचे माहात्म्य वर्णिलेले आहे. हिमालयाला सर्व पर्वतांचा राजा व देवतात्मा मानतात. त्याच्या बाहूतून गंगा, यमुना, सरस्वती, सिंधू, चंद्रभागा, शुतुद्री, वितस्ता, परुष्णी, शरयु इ. पवित्र नद्यांचा उगम होतो.

पुराणांनी सर्व पर्वतांचे दोन वर्ग केले आहेत.

१) वर्षपर्वत : हे निरनिराळ्या देशांच्या सीमा दाखवितात. उदा. : हिमालय

२) कुलपर्वत : हे देशातील प्रांतांच्या सीमा दाखवितात. हे सात आहेत.

महेंद्र, मलय, सह्य, शुक्तिमान, ऋक्ष, विंध्य व परियात्र अशी त्यांची नावे आहेत.

मैत्रायणी संहिता व काठक संहिता यात एक कथा आढळते, ती अशी :

पूर्वी पर्वतांना पंख होते व ते पक्ष्याप्रमाणे उडू शकत. ते सदैव असे उडून स्थलांतर करू लागल्यामुळे पृथ्वीचा तोल ढळू लागला. म्हणून मग इंद्राने त्या पर्वतांचे पंखच कापून टाकले. तेव्हापासून त्यांचे उडणेच बंद झाले. या कथेचा उगम वेदपूर्व काळात झाला असावा. पुराणात व महाकाव्यात ही कथा आहे.

प्राचीन काळी शेती करणारे लोक इंद्र या पर्जन्यदेवतेची पूजा करीत होते. कृष्णाच्या वेळी वज्रमंडळातले (वसाहत) लोक पावसाळा संपल्यावर इंद्राचा उत्सव करीत. हे लोक गोपालक होते व त्यांचा संबंध इंद्रापेक्षा पर्वताशी जवळचा होता. गिरिकंदरात त्यांच्या गायी चरत व पुष्ट होऊन भरपूर दूध देत, म्हणून इंद्राऐवजी पर्वताला देवता मानून उत्सव सुरू करावा, असे कृष्णाने सांगितले आणि गोवर्धन पर्वताला पूजोत्सव सुरू केला.

तेव्हापासून पर्वतपूजा प्रचलित झाली. आजही वैष्णव लोक जन्माष्टमीला व भागवत सप्ताहात मातीचा किंवा लाह्यांचा गोवर्धन बनवून त्याची पूजा करतात.

मानवाचा फुलांशी संबंध अतिप्राचीन काळापासून आलेला आहे. स्त्रियांचा आणि फुलांचा संबंध तर अनादिसिद्ध आहे. ऋग्वेदात स्त्रक म्हणजे पुष्पमाला हिचा उल्लेख आलेला आहे. अश्विनीकुमारांच्या गळ्यात कमलपुष्पाचे हार होते, असे ऋग्वेदात सांगितले आहे. वनवासात असताना सीताही कमलमाला गळ्यात घालत होती, असा उल्लेख रामायणामध्ये आहे. वाल्मिकीच्या काळातील साजशृंगार अंकुर, पुष्प, माला किंवा पल्लव यांनी होत असे. सीतेला अर्जुन, तिलक व कर्णिकार या वृक्षांची फुले फार प्रिय होती.

स्त्रियांप्रमाणेच पुरुषांनाही फुलांची व हारांची आवड होती. रंगीबेरंगी फुलांच्या माळा घालून फिरायला जायचा अयोध्येतील पुरुषांचा रिवाज होता.

काही फुले प्रतीकरूपाने अर्थ व्यक्त करतात. शिरीषाचे लाल फूल अनुराग व प्रणय याचे द्योतक मानले जाते, तर कमल हे पावित्र्याचे सूचक मानले आहे.

देवपूजेत पुष्प हा एक स्वतंत्र उपचार मानला आहे. विशिष्ट देवतांना विशिष्ट फुलेच प्रिय असतात व काही निषिद्ध असतात. देवाला ताजी, चांगली व स्वहस्ते तोडलेली फुले वाहिल्याने देव प्रसन्न होतो, असे अग्निपुराणात सांगितले आहे. मोठमोठ्या देवालयातून देवाला लागणारे हार व माळा तयार करण्यासाठी पुष्पबंधन नावाचा मंडप असतो.

लोकमानसात पृथ्वीची पूजा प्रचलित आहे. पृथ्वी ही माता आहे, ही धारणा लोकसमूहात सर्वत्र आढळते. पृथ्वी धान्ये आणि औषधी वनस्पती उत्पन्न करते, त्यामुळे प्राणिमात्राचे पोषण होते, या कारणाने लोकांनी पृथ्वीला देवत्व दिले आहे. विष्णू हा सृष्टीचा पालनकर्ता व पृथ्वी ही पालनकर्ती मानली असल्याने तिला विष्णूची पत्नी मानले आहे.

प्रात:स्मरणात पृथ्वीची क्षमायाचना केलेली आढळते, ती अशी :

समुद्रवसने देवि पर्वतस्तनमण्डले ।
विष्णुपत्नी नमस्तुभ्यं पादस्पर्शं क्षमस्व मे ।।

याचा अर्थ असा :

समुद्ररूपी वस्त्र नेसलेल्या आणि पर्वतरूपी स्तनमंडले असलेल्या, हे विष्णुपत्नी देवी, तुला नमस्कार असो. माझ्या पादस्पर्शाबद्दल तू मला क्षमा कर.

ज्या ठिकाणी एखाद्या वास्तूची उभारणी करायची असेल, त्या जागी प्रथम भूमिपूजा करण्याची चाल सर्वत्र आहे. शेतकरी समाजात पेरणीच्या आधी भूमिपूजा करायची तसेच धान्य मळण्यापूर्वी शेतकऱ्यांमध्ये खळ्याची पूजा करायची पद्धत आहे.

भारताचा दक्षिणभाग हे हिंदी महासागरातील निमुळते होत गेलेले एक मोठे द्वीपकल्प आहे. या द्वीपकल्पाला सुमारे २५०० मैल लांबीचा समुद्रकिनारा लाभलेला आहे. त्यामुळे भारतीय लोकांच्या जीवनात समुद्राला फार मोठे स्थान लाभलेले आहे. गुजरातमध्ये खंबायतजवळ लोथील येथे सिंधुसंस्कृतीचे जे अवशेष सापडले आहेत, त्यात एक गोदीचा बंधारा आहे, तिथे एक बंदर असावे, असे वाटते. यावरून वेदपूर्वकालीन भारतीय लोकांना सिंधुसंस्कृतीच्या काळापासून समुद्र परिचित असावा, असे अनुमान केले जाते.

जातकसाहित्यात समुद्रमार्गे देशांशी व्यापार करणाऱ्या साहसी पुरुषांच्या अनेक कथा आहेत. त्याचप्रमाणे रामायण व महाभारत या ग्रंथांतही समुद्रप्रवासाचे उल्लेख आढळतात. पुराणांत समुद्राला नद्यांप्रमाणेच पवित्र मानले आहे. पर्वकाळी समुद्रस्नान करणे अत्यंत पुण्यप्रद मानले जाते. समुद्रकाठी संध्या केली असता शतपट पुण्य लागते, असे म्हणतात. गर्भधानाच्या विधीने समुद्राला आवाहन करतात, कारण त्यामुळे विघ्ने नष्ट होतात. श्रावणशुद्ध पौर्णिमा नारळीपौर्णिमा म्हणून प्रसिद्ध आहे. त्या दिवशी वरुणदेवते प्रित्यर्थ समुद्राची पूजा करून त्याला नारळ अर्पण करण्याची चाल आहे.

छांदोगपरिशिष्टात नदीची व्याख्या दिली आहे, ती अशी :

धनुः सहस्राण्यष्टौ च गतिर्यां सां न विद्यते ।
न ता नदी शब्दवहा गर्तास्ताः परिकीर्तिताः ।।

या श्लोकाचे तात्पर्य असे, की कमीत कमी आठ हजार धनू जिची लांबी आहे, तिलाच नदी म्हणावे.

नद्या पवित्र असतात, जो त्यांच्या जलात स्नान करील त्याला पावन करणाऱ्या असतात, अशी भावना ऋग्वेदकालापासून प्रचलित आहे. भारतात नद्यांविषयी पावित्र्याची आणि आदराची भावना पराकोटीची आहे. व्यासांनी 'विश्वस्य मातरः' = विश्वाच्या माता म्हणून नद्यांना मातृपदवीच बहाल केली आहे. भारताचे उत्तर व दक्षिण असे दोन भाग विंध्य पर्वताने बनविले आहेत; पण आपण धार्मिक कृत्य करताना जो संकल्प म्हणतो त्यात 'विंधस्य दक्षिणे' किंवा 'उत्तर प्रदेशे' असे न म्हणता, 'गोदावर्याः दक्षिणे तीरे' किंवा 'देवायाः उत्तरे तीरे' असा नदीपरत्वे देशविभाग करतो. देवपूजा करतेवेळी जी कलशपूजा करतात, त्या कलशात पवित्र नद्यांनी अव्यक्तपणे प्रवेश करावा, अशी त्यांची प्रार्थना असते. तो श्लोक असा :

गङ्गे च यमुने चैव गोदावरि सरस्वति ।
नर्मदे सिन्धु कावेरि जलेऽस्मिन्स निधिं कुरु ।।

भारतातील लोक तीर्थयात्रेला म्हणून जातात ते मुख्यत्वे नद्यांच्या दर्शनासाठी आणि स्नानासाठीच. कारण धर्मशास्त्रात आणि पुराणात नदीस्नानाचे विशेष महत्त्व सांगितले आहे.

सोमवती अमावस्या, चंद्र-सूर्यग्रहण, संक्रांती, शिवरात्री, अर्धोदय इ. पर्वप्रसंगी नदीवर जाऊन स्नान करावे, असे धर्मशास्त्रात सांगितले आहे. कार्तिकस्नान, माघस्नान, वैशाखस्नान ही स्नानेही नदीच्या पाण्यातच करावी असे शास्त्रवचन आहे. जी निरनिराळी काम्य किंवा नैमित्तिक व्रते आहेत, ती सुरू करण्यापूर्वीही नदीस्नान विहित आहे.

जिथे दोन नद्यांचा संगम होतो, अशा स्थानाला प्रयाग म्हणतात. अशा प्रयागात स्नान करणे अत्यंत पुण्यप्रद मानलेले आहे. नदीवर स्नानाला जायचे म्हणजे केवळ तिच्यात डुबकी मारायची असे नव्हे. त्याआधी नदीची पूजा करायची असते व स्नानानंतर तिच्याच जलाने तिला अर्घ्य द्यायचे असते. सुवासिनी स्त्रिया तर नदीची खणानारळाने ओटी भरतात आणि तिला सौभाग्यवानही देतात. ही प्रथा रामायणकालापासून प्रचलित आहे. सीता जेव्हा प्रभू रामचंद्राबरोबर वनवासाला निघाली तेव्हा नौकेत बसून गंगापार करताना तिने गंगेला पुढील नवस केला.

'हे गंगे, वनवासातून जेव्हा आम्ही सुखरूप परत येऊ, तेव्हा येताना मी तुझी पूजा करीन.'

अशी एकेक नदी म्हणजे संस्कृतीचा एकेक प्रवाहच ! पण प्रत्येकाची खुबी वेगळी. नदीचे अखंड वाहतेपण ध्यानी घेऊन तत्त्वचिंतकांनी जीवनाला नदीचा दृष्टान्त दिला आहे.

आपल्या परंपरेतील प्रत्येक सण हा या ना त्या प्रकारे निसर्गाशीच जोडला गेलेला आहे, निसर्गाशी संबंधित घटनांमधूनच सुरू झाला आहे.

आपल्या भारतीय परंपरेनुसार नववर्ष येते ते गुढीपाडवा या सणाच्या दिवशी. ते येते निसर्गचक्राची एक सुंदर लय पकडून, वसंतागमनाची वार्ता घेऊन, आम्रमंजिरीचा, निंबफुलांचा मधुर गंध घेऊन, पिंपळपानांची सळसळ घेऊन. सारी सृष्टी जणू नव्या पालवीची पताका घेऊन उभी असते. म्हणून आपलं नववर्ष म्हणजे निसर्गाच्या वसंतवैभवाचा उत्सव आहे.

चमचम करती नभात तारे
आनंदाचे सुटले वारे
तिळगुळ रंगित घ्यारे घ्यारे
संक्रांत रजनी म्हणा म्हणा रे
देऊ घेऊ तिळगुळ लाडू
हेवे दावे मोडुन काढू
संक्रांतीला साक्षी ठेवू
स्नेह वाढवू प्रेम वाढवू

असं हे पूर्वजांनी ओळखलेलं नातं आहे. विजयध्वज उभारण्याचा, मिष्टान्नाचा, शुभ संकल्पाचा, नववर्षारंभ निसर्गाचा, पर्यावरणाचा व्हावा, असं संगितलेलं आहे.

सूर्य एका राशीतून दुसऱ्या राशीत संक्रमण करतो, त्याला संक्रांती म्हणतात. राशी बारा असून, सूर्य प्रत्येक मासात एका राशीतून दुसऱ्या राशीत जातो, म्हणून प्रत्येक वर्षात बारा संक्रांती होतात. मात्र जेव्हा तो आषाढ मासात कर्कराशीत व पौष मासात मकरराशीत प्रवेश करतो, ते दिवस महत्त्वाचे मानले जातात. कारण कर्कसंक्रमण दक्षिणायनात व मकरसंक्रमण उत्तरायणात होते. मकरसंक्रमणाचा दिवस विशेष पुण्यप्रद मानला जातो.

संक्रांतीव्रत केल्यामुळे सर्व पापांचा नाश होतो, आधिव्याधींचे निराकरण होते आणि सुखसंपत्तीची व सुपुत्रांची प्राप्ती होते, असे सांगितले आहे.

दसरा हा भारतातील सार्वत्रिक सण आहे. सर्व जातीचे लोक हा सण पाळतात. हा सण फार प्राचीन काळापासून चालत आलेला दिसतो. प्रारंभी तो कृषिविषयक लोकोत्सव होता. पावसाळ्यात पेरलेल्या शेतातले पहिले पीक घरात आल्यावेळी शेतकरी हा उत्सव करीत. नवरात्रात घटाखालच्या स्थंडिलावर नऊ धान्यांची पेरणी करतात व दसऱ्याचे दिवशी त्या धान्यांचे वाढलेले अंकुर उपटून देवाला वाहतात. या गोष्टी या उत्सवाचे मूळ कृषिस्वरूप व्यक्त करणाऱ्या आहेत. कित्येक ठिकाणी शेतातल्या लोंब्या तोडून आणून त्या प्रवेशव्दारावर तोरणासारख्या बांधतात; ही प्रथादेखील या सणाचे कृषिविषयक स्वरूपच व्यक्त करते.

वृक्षवल्ली आम्हा सोयरी वनचरे ।
पक्षीही सुस्वरे आळविती ।।१।।
येणे सुखे रुचे एकांताचा वास ।
नाही गुण-दोष अंगा येत ।।२।।
आकाश मंडप पृथ्वी आसन ।
रमे तेथे मन क्रिडा करू ।।३।।
कथाकमंडलू देह उपचारा ।
जाणवितो वारा अवसरू ।।४।।

तुकाराम महाराजांच्या या अभंगातून आपल्या परंपरेने मानवी जीवनातील सुख-दु:खांचा संबंध वृक्षवल्लींशी जोडलेला आढळतो. वृक्ष हे मानवांना व अन्य प्राणिमात्रांना छाया, निवारा, पाने, फळे, फुले, इंधने, औषधी इ. देऊन विविध प्रकारे उपयोगी पडतात. वृक्षांच्या या परोपकारी स्वभावाचा महिमा भारताच्या सर्व भाषांत गायिला गेला आहे. एक संस्कृत सुभाषित :

छायायन्यस्य कुर्वन्ति तिष्ठन्ति स्वयमानपे ।
फलन्ति च परार्थेषु नात्महेतोर्महाद्रुमाः ।।

याचा अर्थ असा :

महावृक्ष उन्हात उभे राहतात आणि अन्यांना सावली देतात, ते दुसऱ्यांसाठी फळे धारण करतात, स्वत:साठी नाही.

मराठेशाहीतील रामचंद्रपंत अमात्य यांच्या आज्ञापत्रात वृक्षसंवर्धनाबद्दल असे वर्णन येते :

"स्वराज्यातील आंबे, फणस आदिकरून लाकडे आरमाराच्या प्रयोजनाची, परंतू त्यास हात लावू नये. काय म्हणोन की, झाडे वर्षा-दोन वर्षांनी होतात असे नाही. रयतांनी ही झाडे लावून लेकरांसाठी बहुत काळ जतन करून वाढविली. ती झाडे तोडिल्यावर त्यांचे दु:खास पारावार काय? एकास दु:ख देऊन जे कार्य करीन म्हणेल ते कार्य करणारास हित स्वल्पकाळचे बुडोन नाहीसेंच होते; किंबहुना धनियाचे पदरी प्रजापिडण्याचा दोष पडतो. या वृक्षांच्या अभावें हानिही होत्ये. याकरितां हे गोष्टी सर्वथैव होऊं न द्यावी. कदाचित एखादें जें झाड बहुत जीर्ण होऊन कामातून गेले असले तरी त्याचे धन्यास राजी करून घेऊन, द्रव्य देऊन, त्याचे संतोष देऊन तोडून न्यावे. बलात्कार सर्वथैव न करावा."

म्हणजेच आपल्या परंपरेतील वैदिक वाङ्मयापासून ते मराठेशाहीच्या काळात देखील वृक्षांचे महत्त्व वर्णिलेले आहे.

कुठलीही संस्कृती काळानुरूप बदलत असेल तरच ती समाजाचे खरे प्रतिनिधित्व करते. याप्रमाणे भारतीय संस्कृतीदेखील काळानुरूप अधिकाधिक लवचिक होत गेली व समाजात झालेल्या बदलांना तिने आपल्यात सामावून घेतले. त्याचप्रमाणे आपल्या परंपरेतील निसर्गविषयक श्रद्धा टिकवून ठेवल्या आहेत. आज त्यांचे स्वरूप जरी बदलले असले, तरी त्यामागील भावना समाजात कायम आहेत हे आपल्याला 'चिपको आंदोलन' सारख्या घटनांमधून दिसून येते.

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संदर्भ

१) भारतीय संस्कृतिकोष - (चौथा, पाचवा, आठवा, नववा, खंड)- पंडित महादेवशास्त्री जोशी.

२) तुकारामगाथा.

३) रामचंद्रपंत अमात्य यांचे आज्ञापत्र.

Mathematics in Nature

Abhay Soman
T. Y. B. Sc. (Mathematics)

Have you wondered how rainbows or sand dunes form? Why drying mud forms polygon-shaped cracks? How birds fly? The visible world is full of patterns and these patterns can be described mathematically. It was Galileo who famously observed that the great book of nature is wide open before us and true philosophy is written in it in the language of mathematics.

In this essay, I would like to discuss the pattern of mud cracks. We shall have to assume two things, viz. (i) mud is level, homogeneous and chemically inert, and has a flat, exposed surface; and (ii) surface tension is uniform everywhere, and it increases progressively as mud dries until it exceeds the rupture strength of the material.

I shall try to show that mud crack patterns are based upon the principle of least work.

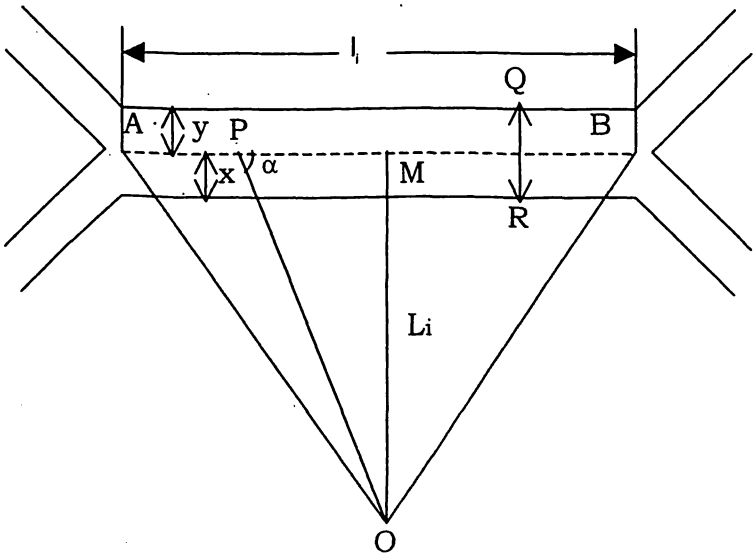

Fig. 1

Suppose T to be internal tension per unit length at any instant, and suppose it to be constant in every direction at every point. Let rupture occur for a unit depth. Under this tension the rectilinear crack has opened uniformly along its length by an amount RQ, which is the width of the crack. This width is the direct result of shrinkage of the material perpendicular to the axis of the crack, which while varying from crack to crack, is

assumed to be constant for each individual crack. Now consider a crack of length l_i arising from a shrinkage x on one side of the axis AB. To find tension per unit length, we use Hooke's Law, which states that when an elastic body is stretched beyond its length, tension is developed in that body. Therefore,

$$T = \frac{Ex}{L_i}$$

where E is the modulus of elasticity.

Work done by a tension T in shrinkage is given by

$$W_s = \int_0^x T\,dx = \frac{E}{L_i}\int_0^x x\,dx = \frac{Ex^2}{2L_i}$$

$$Ws = \frac{Ex^2}{2L_i}$$

As tension per unit length is constant in every direction at every point, at the instant when rupture occurs, the tension along OP is the same as that along OM; i.e. at the instant of rupture, the tension along any direction is the same as the tension along OM.

From fig. 1, $\text{Sin}\,\alpha = \frac{L_i}{OP} = \frac{Ex}{T}\cdot\frac{1}{OP}$

$$\Rightarrow \frac{x}{\text{Sin}\,\alpha} = \frac{T\ OP}{E} = \frac{L_i}{\text{Sin}\,\alpha}\cdot\frac{T}{E}$$

$$\Rightarrow T = \frac{Ex}{L_i}$$

Now, the amount of work done by tension acting across the entire length l_i of the crack is given by

$$W_i = \tfrac{1}{2}\,\frac{Ex}{L_i}\cdot x\,l_i$$

$$W_i = \tfrac{1}{2}\,T\,l_i\,x$$

Thus work done per unit area is given by

$$\frac{W_i}{A_i} = \tfrac{1}{2}\,\frac{T\,l_i\,x}{A_i} \quad \text{Where } A_i = \text{area of } \Delta AOB = \tfrac{1}{2}\,l_i\,L_i$$

$$\therefore \frac{W_i}{A_i} = \frac{T^2}{E} \text{ or } W_i = \frac{T^2 A_i}{E}$$

Similarly, for adjoining sides, the corresponding relation will be

$$\frac{W_{i+1}}{A_{i+1}} = \frac{T^2}{E} \text{ or } W_{i+1} = \frac{T^2 A_{i+1}}{E}$$

Hence, total work done by the tension adjacent to and within an n-sided closed convex polygon is

$$\frac{A^2T}{E} = {}_iA\sum_{i=1}^{n} \frac{T^2}{E} = \frac{{}_iA^2T}{E}\sum_{i=1}^{n} = {}_iW\sum_{i=1}^{n} = W$$

and work done per unit area is

$$\frac{W}{A} = \frac{T^2}{E}$$

From the above relation it is clear that work done per unit area is minimum when area A is maximum. Here we have considered A as the area of an n-sided closed convex polygon. Our problem is to find out when this will occur. The answer is, when the polygon is inscribed in a circle. To prove this we require some preliminary theorems.

Theorem 1: Isoperimetric Theorem: The circle encloses the largest area among all closed curves with a prescribed length.

Suppose C to be the closed curve which is required, i.e. C has the largest area with the prescribed length. We claim that C must be convex, i.e. if we join any two points of C by a straight line, then that straight line should lie inside or on C. Suppose this is not true. Then there exists a straight line (say) OP joining two points, O and P, on curve C such that OP does not lie inside C, as shown in fig. 2. Then arc OQ'P is the reflection of arc OQP in a line OP. Now if we consider arc ORP together with arc OQ'P then this new curve is again closed but with an area larger than that of the original one. This contradicts our assumption that C is the required curve. Hence C must be convex. Now consider line AB dividing curve C into two equal arcs where A and B lie on C. Then AB must divide the area of C into two equal parts. This is possible since if AB divides C into two different areas then we can take the reflection of the larger area in line AB to get another curve that is closed and has a larger area. This again leads to a contradiction.

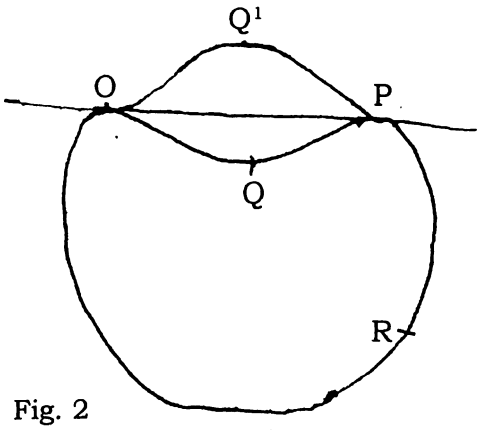

Fig. 2

It follows that half of solution C must solve the problem, which is to find an arc of length L/2 having its endpoints A and B on a straight line and enclosing maximum area between itself and this straight line. Our claim is that the solution of this problem is a semicircle, i.e. $\angle AOB$ must be of 90^0. Let us suppose the contrary, i.e. let $\angle AOB \neq 90^0$. Then fig. 3(a) can be replaced by fig. 3(b), without changing the shaded area and the length of the arc AOB. But the triangular area is increased by making

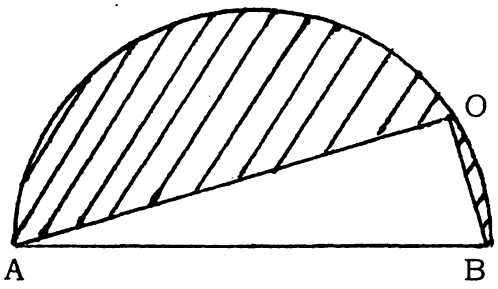

Fig. 3(a)

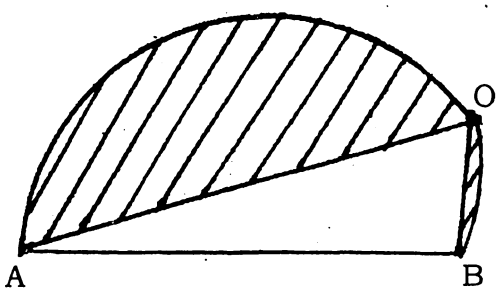

Fig. 3(b)

$\angle AOB = 90^0$ in fig. 3(b). Thus fig. 3(b) has a larger area than fig. 3(a). This contradicts our assumption that $\angle AOB \neq 90^0$. Hence $\angle AOB$ must be of 90^0, which implies that the required arc is a semicircle.

Theorem 2 : If in a triangle, one side is given to be C and the sum of the other two sides a + b is given, then among all such triangles the one with the largest area is an isosceles triangle.

For proving this we will first prove that for an isosceles triangle, a + b is minimum for a given area A and side C = PQ.

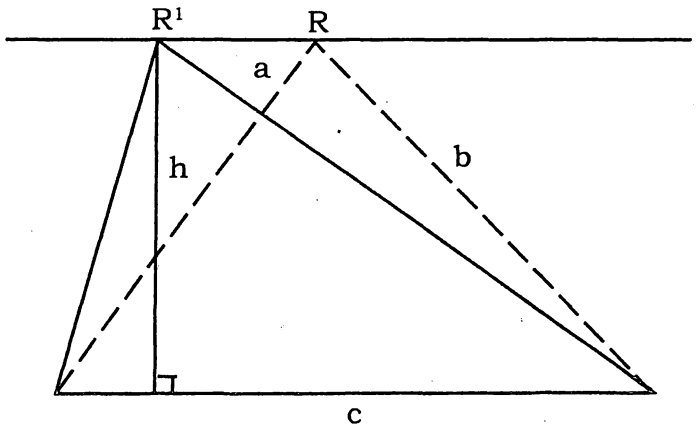

Fig. 4

The area of a triangle is equivalent to ½ x attitude x PQ, i.e. ½ x h x c. Thus to find point R such that distance from R to line PQ is equal to h, and the sum a + b is a minimum, R must lie on line parallel to PQ at distance h. This happens when P and Q are equally distant from B.

Now returning to our original problem, any triangle other than an isosceles triangle with base c and the same area as that of the isosceles triangle has a greater value of a + b. Hence any other triangle with the same values of a + b and c as the isosceles triangle must have a smaller area. Thus theorem 2 is proved.

Theorem 3 : Of all n-gons with side lengths a_1, a_2, ..., a_n, arranged in that order, the one inscribed in a circle has the greatest area.

Consider polygon P inscribed in a circle C. Then "cut off" the n segments and add them to the corresponding sides of any other polygon P' not inscribed in a circle. Now the union of these circular arcs forms a continuous closed curve C' (as shown in fig. 5), which is equal in length to the perimeter of circle C. This is because we have constructed C' with the same circular arcs.

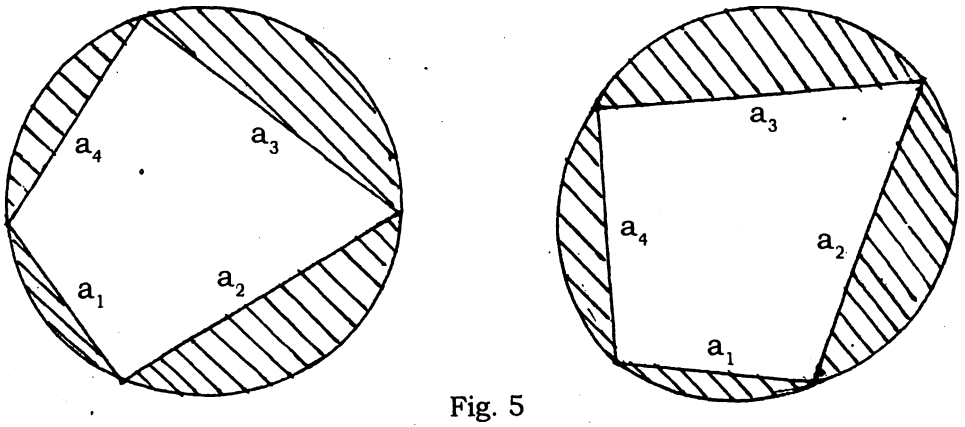

Fig. 5

Now, area of C = Area of P + Total area of n segments.

Thus, by Theorem 1, area of circle C exceeds that surrounded by the curve C', where

Area of C' = Area of P' + Total area of n segments.

Since the total area of n segments is equal in both C and C', and since area of C > area of C', we have area of P > area of P'.

Theorem 4 : Given a set of n side lengths in a given order, there exists a polygon composed of these sides that can be inscribed in a circle.

Consider a point Q in the interior of an irregular convex n-gon. Q can be taken anywhere inside the polygon, i.e. the position of Q can be changed.

Now construct all n triangles $\Delta 1$, $\Delta 2$, ..., Δn, with sides a_1, a_2, ..., a_n as bases respectively and with vertex as Q. Let the sides joining edge of a_i be r_i and r_{i+1}. A_i has the maximum area if and only if $r_i = r_{i+1}$ for all i = 1, 2, ..., n (by theorem 2). Hence $r = r_1 = r_2 = \ldots = r_n$. This forces Q to the centre O of a circle of radius r in order that the polygon can have the maximum area. Now to find this centre, consider an irregular n-gon inscribed in a circle of radius r, with each side a_i subtending an angle $2\theta_i$ at the centre O. The perimeter of n-gon P is

$$P = \sum_{i=1}^{n} a_i = 2r \sum_{i=1}^{n} \text{Sin}\,\theta_i$$

and $\sum_{i=1}^{n} \theta_i = \pi$ i.e. $\sum_{i=1}^{n} \text{Sin}^{-1}\left(\frac{a_i}{2r}\right) = \pi$

For regular polygons θ_i (r) has unique solution.

We get, $\theta = \frac{\pi}{n}$ and $r = \frac{a}{2}\ \text{cosec}\ \frac{\pi}{n}$.

From all the above work, it is clear that mud cracks are formed in the shape of polygons, with each polygon inscribed in a circle with centre O, which is the point of zero displacement, so as to increase area, in turn to decrease work done per unit area. The existence of such a circle is guaranteed by theorem 4. Thus, drying mud crack pattern is explained mathematically.

All existing natural phenomena follow specific precepts that could be revealed mathematically. Mathematics can be used as an effective tool to obtain the consequences of phenomena as also to reveal the general patterns of these phenomena. One should not fail to notice that there is amazing unity in nature. From striped patterns of tiger skins to colourful spots on the wings of butterflies, from the wave patterns that move across oceans to the various cloud patterns in the sky, from the formation of rainbows to the scattering of light in the dawn and twilight skies--all these patterns can be described using mathematics. In view of this, one cannot but agree with Galileo and say that mathematics, indeed, is the language of nature.

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The Ethics of Environment

Kaushika Draavid
S. Y. B. A. (Philosophy)

The term 'nature', used in a collective sense[1], encompasses a wide range of phenomena. It is the world with all its features and components. It is also the power producing these. When we hear the word mentioned or when we think about it, the image that appears before our mind's eye is always that of something that is utterly independent of human agency. Thus, **the concept of nature is understood, generally, in contrast with that of culture.** Furthermore, we believe that all activities of human beings, all departments of thought and action in the human world, which constitute this other concept culture, are based upon nature and influenced by nature. This does not, however, imply that the idea of nature in general is worked out first, in isolation with any human activity, and that when this understanding of nature is complete, we go on to erect upon it superstructures of various fields of thought and action. Rather, what we do is, we begin with the small details around us, the individual problems that we tackle in our everyday lives, and once these have accumulated to a considerable amount, we reflect upon the work we have been doing and discover that we have been doing it in accordance with certain principles. The detailed work could be in natural science, economics, law or any other field; **the reflection on the principles underlying these fields is what we call philosophy.** So, temporally, philosophy comes after 'non-philosophy'; but the two are so closely related that non-philosophy or detailed work can seldom go on for long without philosophy beginning.

The philosophy of nature has been active since the time before the beginning of the Common Era. (This is true of India as well as the West; however, the present essay is located by and large within the framework of Western philosophy.) It has several areas. The **philosophy of natural science** concentrates on scientific concepts and methods and the interpretation of scientific theories. **Aesthetics** focuses on the experience of art and the values pertaining to it such as harmony, order and balance, which are inspired by nature. Over the past quarter century, a new field of study called **Environmental Ethics** has emerged that focuses directly on the themes of nature, the natural environment, and related issues of value, ethics and society. It forms a crucial part of Applied Ethics—crucial for the guidance of individuals, corporations and governments in determining the principles affecting their policies, lifestyles and actions across the range of environmental issues.

The principal aim of environmental ethics is to criticise and improve

[1] In this sense, the word is used for the sum total or aggregate of natural things. This is its secondary sense. In its original and proper sense, it refers to something within a thing which is the source of its behaviour. For example, the nature of water is to flow.

the values and principles in terms of which we understand our responsibilities to future generations, our relationship to nonhuman creatures, and our place in nature generally. Its scope, in space, is at least as extensive as the biosphere of the planet. Missions into the outer space and their related debris have extended its realm to the distant zones of the solar system. In time, its scope extends, according to many, for as long as human action can exercise any kind of impact on anything of value.[2] On this view, its temporal scope turns out probably to transcend the future existence of humanity.

Within the very broad field of environmental ethics, Anthropocentrism, Biocentrism and Ecocentrism are the three major philosophical positions about the relation human beings have with other species and the environment, and about the source and locus of value, which determine the nature of this relation. Another noteworthy environmentalist view is that of **Ecofeminism**. Ecofeminists have compared traditional exploitative attitudes to nature and women, both resulting from a patriarchal outlook that views the two as things to be controlled and harnessed. They have suggested, further, that women, because of their biological and/or social roles as lifegivers and nurturers, are closer to nature than men, and that the solution of current environmental problems is possible only when related feminine qualities such as caring and preserving are allowed to mould social life and policies. We do not know whether gender-related qualities as such exist. We may also ask whether saying that they do is not a further instance of gender stereotyping. But we cannot refute the ecofeminist claim that a more 'feminine' world is needed to facilitate environment-friendly attitudes and policies.

I shall now return to the three environmentalist views named before. anthropocentrism, biocentrism and ecocentrism illustrate how our attitude towards other beings and things depends on what kind of creatures or objects we take them to be, and how we perceive our relations to them. In other words, our attitude rests on, and is supported by, a belief system that constitutes a view of nature and our place in it. The question of **'intrinsic value'** [3] and its location and extension becomes very pertinent here.

Anthropocentrism, which literally means human-centredness, maintains that only humans have intrinsic value. The nonhuman world has value only insofar as it is instrumental in satisfying human desires. Traditional justifications for this view have revolved round distinctive

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[2] This is not a purely theoretical point. Nuclear energy generation and experimentation are already emitting into our environment radioactive substances with half-lives of millions of years, with predictable harmful effects on almost any creature which comes into contact with them.

[3] The kind of value that a being or thing is held to have in its own right. It is neither instrumental nor in any other way derivative, but depends entirely on the nature of its bearer. It is often contrasted with 'instrumental value', which is the value attributed to a being or thing in virtue of its usefulness, usually to a human.

human characteristics, such as having a soul, rationality and language, that set humans apart from the rest of nature and make **ethics an exclusively human affair**. The doctrine of creation has fostered the belief that humans were made in the image of God and share in God's transcendence of nature, and that the whole natural world was created for their sake. There are also secular (non-theistic) sources of the idea. Indeed, without a belief in God, humans are left to their own devices. Thus, "man [becomes] the measure of all things", as the Greek philosopher Protagoras said. His saying captures the idea that people can only know that which they have the faculties and capacities to become acquainted with, and so whatever objective reality might be, reality for them is only such as their minds make it.

Whatever their source, justifications for anthropocentrism generally appeal to characteristics of humans that mark them off from the rest of the natural world. The view that humans are uniquely rational beings, and that this constitutes their greatest perfection, is held not only by theologians like Aquinas, but also by secular philosophers like Kant. The claim that nonhuman beings lack the requisite rationality is buttressed by various sorts of evidence. The absence of language in them is seen to indicate an absence of thought. That they do not appear to be capable of formulating intentions or manipulating symbols is seen to show that they cannot form the concepts which are necessary for rationality. **If nonhuman beings have no conception of right and wrong, it is argued, they are not in a position to make any moral claims against humans.** Humans, then, uniquely, are the addressees of moral imperatives and obligations.

It is argued not only that anthropocentrism is justified, but also that to try to avoid it is neither possible nor desirable. As humans, we cannot but interpret the world in terms of human values, and it is only natural for us, as members of our species, to care for other members of our own species. Even if one is motivated to care about nonhuman entities, there are limits to how successful one might be, for there are limits to possible human knowledge of what is really good for them. Also, humans must consume other living entities and use nature in various ways in order to survive.

The arguments justifying anthropocentrism have force and appeal, but they are not without their problems. To begin with, the Judaeo-Christian presumption of human dominion on earth is the product of just *one* sort of worldview; there are religions and cultures that take a quite different view: Buddhists, Hindus and Jains, for instance, have a humbler estimate of the human place within nature and a greater solicitude for other living beings. Other cultures view the earth itself as a living conscious being to be treated wity respect. Criticism of the factual basis of anthropocentrism has come from scientific findings which undercut claims for the uniqueness of certain human faculties and characteristics, and show humans instead to be **a product of natural evolutionary processes**, to have considerable affinities with other creatures, and to have a vulnerable dependence on ecological conditions of existence. Furthermore, one cannot

justifiably privilege humans ethically by saying that they alone have the requisite rationality, for even among humans there are many who lack full rational capacities, such as children and mentally disadvantaged people, but they are held to have justifiable moral claims. This **'argument from the marginal cases'** illustrates that having the capacity of moral *agency* is not a necessary condition for being considered as a moral *patient*. Whoever possesses the capacity to suffer harm and to benefit from moral status is a proper object of moral consideration. So nonhuman beings as well as children and the mentally deficient or deranged are to be considered under moral patienthood.

There is no longer any unassailable reason, then, to assume that only what befalls humans matters morally. There are proposals, accordingly, from various quarters for an extension of ethics to cover broader interests than those covered by anthropocentrism. One way of doing this is to move in the direction of **sentientism**. This means giving moral consideration to the interests of any and all sentient beings—that is, beings capable of experiencing pleasure and/or pain—and regarding it as morally relevant that these interests are not being made to suffer. What this means in practice is that one is morally committed to opposing the cruel treatment of animals. It may also be required to go beyond this and have regard for animals' social, psychological and emotional lives. Some animal rights campaigners go even further and require an end not only to clear-cut abuses of animals, but to any *use* of them whatsoever. This is grounded in the 'subject of a life' criterion of moral considerability.

Biocentrism casts the ethical net more widely still to extend moral consideration to *all* living entities, including plants. Since nonsentient creatures, as well as sentient ones, are capable of flourishing, it is not unreasonable to ascribe to them an interest. Trees, for instance, show capacities for respiration, ingestion, growth, self-maintenance and reproduction. Thus, if the flourishing of sentient creatures is of value, it is hard to deny that the flourishing of trees is too. **All living things have intrinsic as well as instrumental value.**

The moral obligations advocated by biocentrism to the living world are not indirect obligations to humans. We are urged to conserve nature not because its loss threatens us with scarcity of resources, or spiritual and/or aesthetic impoverishment, or both; we are urged to do so because the nonhuman, natural world is deemed to possess some sort of value that is independent of our modes of valuing it. Richard Routley's **'last man argument'** drives this point home quite effectively. It posits a scenario in which all conscious life forms have been destroyed, bar one human—a man, in Routley's example—and in which there is no possibility of conscious life evolving again. The last man, who will shortly die too, has the option of destroying life on earth, which still supports thriving communities of trees, grasslands and so on. We are to ask whether it matters if he destroys the surviving earth life. The commonly held intuition is that it does. This is then taken as evidence that nonconscious life has some value that is not

dependent on the existence of conscious valuers—and that this value is relevant to the assessment of its moral standing.

Albert Schweitzer, whose ethical position is sometimes referred to as the precursor of modern biocentric thought, articulates a particularly 'pure' form of biocentric thinking, encapsulated by the phrase **'reverence for life'**. He was of the view that all living things have intrinsic value, which can and should be appealed to as the basis for human ethics, and that the attitude of reverence for life would re-establish the connections between ethics and nature held to have been severed by the rise of modern industrial society.

The biocentric outlook is held to support the attitude of respect for nature. An agent who adopts this attitude will consider herself bound to live by a set of moral norms, governing both actions and character development, which manifests a disposition to promote and protect the good of all living things. In practice, this is not always possible. We have to use trees and other plants as resources in all sorts of ways, including as food. How do we tell when our use of the nonhuman is wanton and when it is warranted? Our reasons are liable to be anthropocentric ones. Nevertheless, while there may be no easy answer to such questions, there is value simply in posing them, for this means that we no longer take it for granted that human interests automatically and unproblematically can be pursued regardless of their impact on the rest of living nature.

As an interesting aside, one may note the compatibility of biocentrism with the **Greek view of nature**. The Greek thinkers regarded the world of nature as a world of bodies in motion. These motions were possible due to vitality or soul. But there was also regularity or orderliness in the world. This, they believed, was because of the presence of mind in nature. They accordingly said that **the world of nature is not only alive but intelligent**. "The life and intelligence of creatures inhabiting the earth's surface..., they argued, represent a specialized local organization of this all-pervading vitality and rationality, so that a plant or animal... participates in its own degree psychically in the life-process of the world's 'soul' and intellectually in the activity of the world's 'mind', no less than it participates materially in the physical organization of the world's 'body'." [4]

Anthropocentrism, similarly, can be said to have affinities with the **Renaissance cosmology**.[5] The Renaissance thinkers, like the Greeks, saw in the orderliness of the natural world an expression of intelligence, but

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[4] R. G. Collingwood, *The Idea of Nature*, pp. 3-4.

[5] Collingwood (op. cit., p. 4) uses the term for the cosmological movement that took place in the sixteenth and seventeenth centuries through the writings of Galileo, Descartes, Newton, et. al. This usage might be somewhat misleading, as Collingwood himself hints, because the word 'Renaissance' is usually applied to an earlier phase in the history of thought, beginning in the fourteenth century and continuing with the Platonic and Aristotelian cosmologies. The cosmology that Collingwood calls 'Renaissance' was in principle a reaction against these and might, perhaps, be more accurately called 'post-Renaissance'; but Collingwood finds this a clumsy term.

whereas for the Greeks this intelligence was nature's own intelligence, for them it was the intelligence of something other than nature: God. Their assertion was that **nature is devoid both of intelligence and life**. The movement which it exhibits are imposed upon it from without, and their regularity is due to 'laws of nature', also imposed from without. Instead of being an organism, **the natural world is a machine**, put together and set going for a definite purpose by an intelligent mind outside itself. This view can be said to have provided a metaphysical grounding for the exploitative attitude towards nature that went hand-in-hand with industrialisation in Europe.

The introduction of the idea of evolution into natural science led to the abandonment of the mechanical conception of nature, for it is impossible to describe something in the same breath as a machine and as developing or evolving. On the evolutionary theory, therefore, there may be machines in nature, but nature itself cannot be a machine, for it is not a finished product or closed system.

Moral thinking, likewise, **is not a finished product or closed system** either. It progresses over time, and this progress can be depicted in the form of an expanding circle. Moral obligation was recognised initially towards a narrowly circumscribed group. It widened with the centuries to include more and more groups of beings within its reach. From a position that acknowledged such obligation only to other male members of the same tribe, the circle has expanded to take in slaves, members of other tribes, women and children. Recent stages of development see the inclusion of sentient and, more tentatively, nonsentient individuals. Recognition of the moral status of species and of ecosystems as a whole, including their abiotic constituents, can be depicted as the next step in the history of moral development; and such is the trajectory leading to the development of an **ecocentric ethic**.

Ecocentric approaches typically emphasise the importance, not of individual organisms, but of the relationships between organisms; and between organisms and their environment. The focus thus includes the abiotic as well as the biotic. Ecocentrists therefore tend to resist the biocentrist's exclusive emphasis on individual, living organisms. Kenneth Goodpaster argues that "to be worthy of moral respect, a unified system need not be composed of cells and body tissue: it might be composed of human and nonhuman animals, plants and bacteria" [6], as an ecosystem is.

Goodpaster's approach is developed by Lawrence Johnson who argues that various beings other than individual organisms—such as species and ecosystems—can meaningfully be said to have interests, and that these interests are morally significant. He understands species and ecosystems as living processes, characterised by self-regulation, self-maintenance,

[6] Kate Rawles, *Biocentrism*, Encyclopedia of Applied Ethics, Volume 1, p. 279.

organic unity and so on, which, in his opinion, allows one to say that they have well-being interests—and therefore moral significance.

A different view is articulated by Holmes Rolston who, while denying the dubitable claim that species, ecological systems and ecological processes as such have self-referential interests, insists that we have obligations towards them nonetheless. For him species are dynamic life forms. While the individual is a token of a type, the species defends that type, "pursuing a pathway through the world, resisting death (extinction), by regeneration maintaining a ... [biological] identity over time".[7] Hence, **from the evolutionary point of view, the species is more important.** Rolston also defends viewing ecosystems as real entities, inasmuch as they generate a spontaneous order that envelops and produces the richness, beauty, integrity and dynamic stability of the component parts. They have a distinctive kind of value, described as **systemic**, which is neither intrinsic nor instrumental, and which actually makes these other kinds of value possible.

Ecocentric ethics have phenomenally wide ambits. Everything, from the conscious to the nonconscious and from the animate to the nonanimate, is held to be deserving of moral concern. This may seem a very demanding requirement: in principle, every intervention in nature would have to be investigated for every possible ramification, which would lead to a paralysis of action. Responding to this concern, ecocentric environmental philosophers have distilled certain general principles which they believe can serve as a workable guide to action. Particularly influential is **Aldo Leopold's 'land ethic'** whose basic principle is, **"A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise."** Thus in considering whether to 'develop' a piece of land, for instance, one must not merely consider what material or economic advantage might accrue to humans, but what the effects would be on the land itself.

An interesting point is raised by Rodman regarding environmental ethics in general, which I would like to discuss here. Rodman maintains that **environmental ethics has been constrained by its attempts to function within traditional ethical frameworks.** He suggests that it is not possible to formulate an adequate environmental ethic by extending the range of the contemporary theories, because these theories have evolved to articulate moral claims that arise between people, and are inherently anthropocentric and individualistic. They are thus less than well suited to articulate the moral claims of nonhumans, particularly those who are extremely unlike human individuals.

Rodman argues that Singer's extension of moral standing to sentient animals, and Stone's to living things, for instance, are both expressed in terms of the conventional ethical paradigm, which he describes as focusing

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[7] Holmes Rolston, *Value in Nature and the Nature of Value*, in *Philosophy and the Natural Environment*, p. 21.

on entities, rights and obligations. Both writers allegedly transmit a double message. On the one hand, they argue that the moral status of certain nonhuman beings should be raised, in virtue of morally relevant characteristics that they share with human beings. On the other hand, this very argument is held to degrade these beings, by assimilating them to the status of inferior humans. Rodman's proposal is that, instead of imposing our human-centred views upon nature, we should recognise that we and our ethical theories are placed within a larger normative order. Rodman's views raise a number of pertinent questions. One question is whether sentientist and biocentric attempts like those of Singer and Stone respectively are really inevitably degrading to nonhuman life. Another concerns the possibility of finding norms in nature, while acknowledging the nature of nature as constantly changing.

Perhaps an alternative ethic of the kind acceptable to Rodman is to be found in Callicot's ecocentric approach. He holds that **ethics are rooted in natural sentiments or feelings, such as love, sympathy, empathy, benevolence and respect**, which have evolved in the context of the communities to which we belong, and are directed towards those we perceive as kin and towards communities themselves. Evolution shows us that other living things are kin, and scientific ecology shows us that they are fellow members of biotic communities. Once these facts are properly absorbed, feelings of benevolence, respect and the rest will be triggered. This is in clear contrast to the view that an extension of our ethical concerns to include nonhumans follows as a requirement of moral consistency, upon the perception that nonhumans possess the characteristics relevant to moral considerability. This same view is mirrored in the **'deep ecology'** of the variety developed by Warwick Fox, which considers that if one has a deep enough understanding of the unity of nature, one will (as opposed to should) naturally be inclined to care for it, thereby rendering ethics "superfluous". However, even this model has not been exempted from criticism. Richard Sylvan, for instance, has suggested that shifting the emphasis to experiential concerns may cause a regress into anthropocentrism, inasmuch as our care for nature, in such an account, is founded on the *human* experience of its oneness.

In the face of such nitpicking, one is led to wonder whether a totally nonanthropocentric ethic of the environment is at all possible. Both biocentric and ecocentric view try to overcome anthropocentrism with respect to nature, but the philosophers expounding these views do so as personal women and men and as such they cannot but operate from within a human--though not necessarily human-centred--perspective. As humans they have uniquely personal traits, like freedom and deliberate action, which set them apart from the rest of the beings. To deny this would be to deny the possibility of action, which would in turn make ethics impossible. Accepting these differences, however, does not and should not amount to saying that there is a dichotomy between humans and the rest of organic life. If we consider the principal features of personhood--viz., the powers

of enjoying consciously, thinking logically, remembering, planning, preferring or judging, and acting with moral responsibility--we find that they are not without their analogues and continuities in the nonhuman world. Only moral responsibility seems not to apply outside human persons. But even many human beings, as we have already noted, seem to lack it. The point is, **there are continuities in organic life, from trees to animals to humans. This should imply that there should also be a continuity of morality.**

The reason why anthropocentrism draws flak from nonanthropocentric ethicists is not so much that it talks of a hierarchy in the living world, as that humans arrogantly have used there capacities to ride roughshod over the feelings, endeavours and values of differently endowed other creatures. Is it the case at least that the practices or values identified as anthropocentric serve humanity at large ? To our shame, we see the same unfeeling arrogance and heartlessness in the treatment by some humans of other less powerful humans. The problem then is not so much anthropocentrism, at bottom, as egoism. In fact, there is a case to be made that if people were to become truly anthropocentric and concentrate on their own moral development, recognising that ethics is a peculiarly human affair, they would be liable to do less harm to other beings, albeit for reasons connected with their own moral interest.

Relatedly to the preceding point, it can be argued that humans should exercise prudence in the use of nature's resources and seek to preserve species, biodiversity and so on, for reasons that derive from their own enlightened self-interest. Because they live in one world with the rest of nature, if they make things go badly for its other constituents, things will ultimately go badly for them too. This view, moreover, has motivational advantages over those that appeal to an altruistic concern for nonhumans for their own sake, regardless of their interrelation with humans.

These considerations support the idea that **anthropocentrism, if it is sufficiently enlightened, is capable of supporting environmental values**, at least in some instances, and is hence defensible. Admittedly, there are 'hard cases' where the interests of humans and non humans do not coincide but oppose one another. Perhaps the best way to deal with the moral dilemmas presented by such cases is to recognise that all natural phenomena have some value which must be duly respected, irrespective of its type and degree. While engaging in this endeavour, we are bound to take a human point of view. This, however, does not justify mockery of our efforts as inevitably self-serving. The distribution of moral sensibility among human beings may be uneven but to doubt the very possibility of genuinely moral thought and action by them is cynical. What purpose does it serve to criticise the ethical perspective we are born with? We cannot but exercise our moral agency from within it. It would be more sensible, rather, to talk of enlargening, deepening and refining this perspective.

Conclusion

The planet we inhabit is a superb planet. The elements of life--carbon, oxygen, hydrogen, nitrogen--are common enough throughout the universe, but actual life, as far as we know, is common only on earth. Communities and communities of organisms flourish here. At this scale, then, earth becomes the most valuable entity of all, the producer of all earthbound values and a proper object of intrinsic or systemic valuation itself. Recognising this generates a global sense of obligation. Indeed, environmental valuing is not over until we have risen to this level.

It is true that humans are the only evaluators who can reflect about what is going on at this global scale. This, instead of leading to a human chauvinistic attitude, should generate in us a sense of responsibility and obligation. We should feel enjoined to forge ways of thinking and deliberate measures leading to the conservation of our environment.

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Thou art our need;
and in giving us more of thyself
thou givest us all.

- Kahlil Gibran

मम हृदयान्तरिं ज्ञानफुलांचा फुलबगिचा फुलणार;
फुलांत झुलुनी आत्मदेव मम नवानंद लुटणार.

नवें ओज मज, नवें तेज मज, सर्व नवें मिळणार;
जीर्ण जुन्यास्तव कोण अवास्तव सुज्ञ झुरत बसणार ?

- गोविंद