THE JOURNAL OF INDUSTRIAL DESIGN CENTRE

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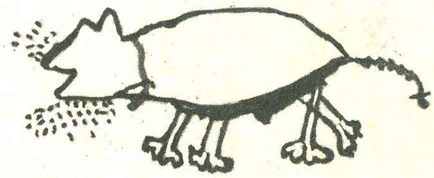
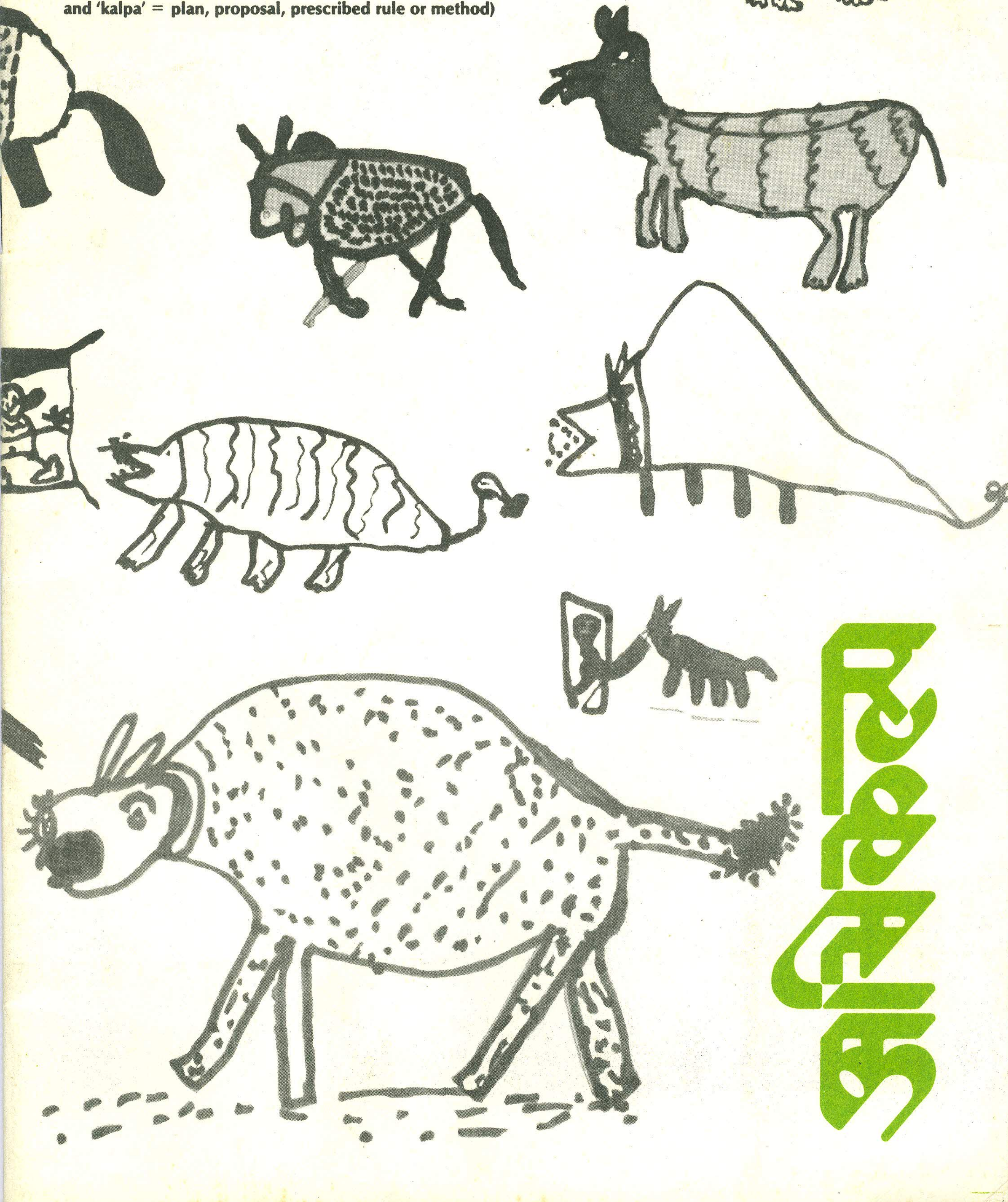
July - December 1984

Abhikalpa

Abhikalpa = Design
(From Sanskrit 'Abhi' = towards, in the direction of; and 'kalpa' = plan, proposal, prescribed rule or method)





अभिकल्प

Abhikalpa

The Journal of Industrial Design Centre

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Contents

Cover: 'Wolves' drawn by school-children

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Conditioned Creativity

Two of the authors in this issue, L.K. Das in his article on 'Epistemology and Techno-cultural Revolution', and A.G. Rao in 'Aesthetics of Problem Perception', stress the need for designers to shed inhibitions as an essential condition for creativity. Though this need is generally recognised by design educators everywhere, design education in most design schools ends up being a process of conditioning the students' minds. Design schools and design teachers have their favourite attitudes and biases which are gradually transferred to the students till they learn to respond in a 'Conditioned Creative' manner. Even the most iconoclastic movements clearly define the framework in which their supporters are expected to operate.

The drawings of wolves, drawn by the students of a primary school in a village in Madhya Pradesh, on the cover of this issue of 'Abhikalpa' are very interesting for two reasons. First, the students had never done drawings before, so they had no notions of what a drawing is supposed to be like. Second, none of them had ever seen a wolf.

In the drawing task suggested to them, the students were asked to illustrate an incident which had occured in their village a few months ago. A wolf had bitten several people sleeping outside their huts on a dark summer night. Though the children missed seeing the wolf, they had all participated in the commotion which followed and had their own vivid images of a wolf as a large ferocious animal. In the children's drawings this large ferocious animal can be seen in physical form ranging from that of a large dog to that of crocodiles, pythons and even imaginary composite images of ferocity. The drawings are the outcome of totally uninhibited minds.

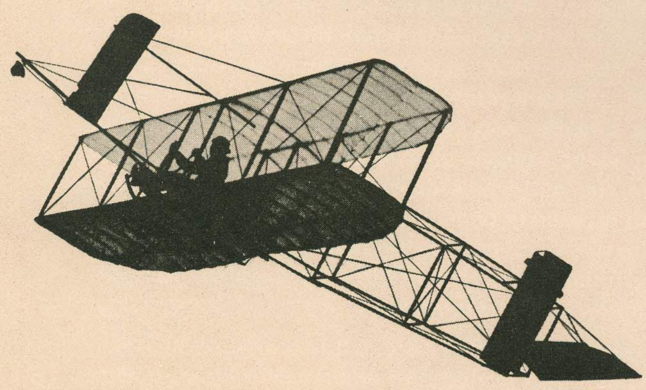
How to preserve this innocence, while teaching the discipline of design, is a problem to ponder over by all design educators.

EPISTEMOLOGY AND TECHNO- CULTURAL EVOLUTION

L.K. DAS

Abstract:

This paper was written in 1977 in response to the nagging need to evolve a non-parochial framework for the study of the development of the man made world. Man and his cognitive capability is assumed as the fountain head of his creative productivity. It is discovered that epistemological styles of metamorphism, rationalism, empericism form a cascadian connectivity at one level; and concepts, structures, machines, controls and systems at another level. In this framework it is possible to view History of Design not only to embrace the entire mileau of human creation but also do justice to the subject as taught traditionally in Design Colleges in India & abroad.



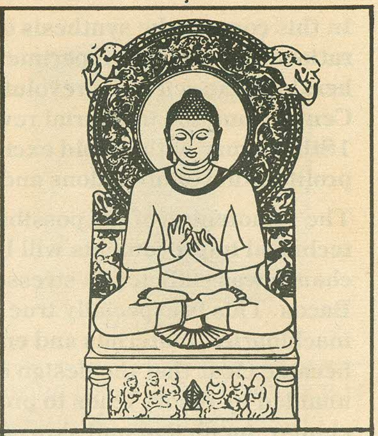
Man's virgin role is that of a designer. Lacking in omnipotence and omniscience, he cannot create out of nothing. He therefore operates by bringing together already existing elements into a new and distinctive relationship to each other and thereby creating a resource that is entirely new and worthwhile. In this manner he devices means to come to term with nature. The talented and socially conscious among such people have been hailed by the needy as the hope of mankind. The conservative vested interests exorcised him as the devil.

Today as ever before the designer remains an existential necessity.

In this action a designer strives to parallel and transcend the perfection in nature, in his thought action and deed. This is the essential underlying thread in the works of Buddha, Mahavir, Michelangelo, Newton, Mendeliev and Wright Brothers. They were master designers for they concerned themselves with the essence of the problem. Their solutions were fundamental, simple and elegant. Their creative act was a total act with which the essentials had been explored and expressed. The two are inseparable. No design effort exists in isolation. It is always related, sometime in a very complex way to an entire constellation of influencing situations and attitudes. As such it is irrelevant to compare a Loin cloth with a saree for each is a unity created in response to the potentialities, opportunities and limitations, desired and imposed, in a given environment. Foremost amongst the constellation of factors is the combination of psychological epistemic styles mentioned by Kearsley (1976). With these the designer also explores and expresses the essentials. Let us briefly dwell on the definition of these styles and then go on excursion relating these to the historical mile-stone of the man-made world.

Michelangelo

Leonardo



Buddha

1. 'Metaphorism' ensures continuity through similarity and synonymity of the different levels, components and structures and thus lends character and identity to the system. It introduces plasticity in thinking and brings about condensation, symbolization, displacement, neologism.
2. 'Rationalism' leads to knowledge structure that is consistent and coherent. It helps divide and distinguish and as such stimulate questions.
3. 'Empericism' ensures that there is compatibility between the knowledge structure and the perceptually verifiable systems. It ensures design operationability and physical realizability.

It is realistic to model designers problem solving as hybridization of these basic styles.

Let us start on our excursion. Throughout the space-time domain we find evidence of the three epistemic styles, however, there is a distinct predominance of one over another. The same is true in specialized disciplines in science, engineering and arts.

Way back some 6000 years in time man projected into nature his own teleonomic functioning and readily adopted his life style to conform to structures existing in nature. His pots, traps, baskets, bins, reservoirs, canals and cities had analogs in nests, beaver dams, geometric bee-hives, urbanoid ant-hills and termitaries. To him metaphorism provided a readily available guide to the design of the man-made world. Besides the ancient religious and mythological scriptures like Bible, Mahabharata, Geeta, Upanisads are essentially vouched in metaphorical language. Works of Jesus & Confucius cannot be understood until capability to fathom the metaphoric contents can be assumed.

Metaphorism, however, as a culturally dominant style of epistemic behaviour was not viable. A system of logic, rules and regulations were necessary for human and physical transactions.

Rationalism received an impetus in the ten-commandments, and the principles of logic, arithmatic and algebra. This facilitated movement towards the concept of a just society, development of administration, monetization of economy, land surveys, development of astronomical tables etc. Depository of ideas came into being for knowledge could now be channelized by reason and generalized to be relevant in different situations.

The conservative proponents of metaphorism sought a system of logic in the metaphoric parallels in nature in contrast to the Euclidian system. Though this tendency had a profound influence on art and architecture in the system of colours and proportion, but as a tool to arrive at truth and create a world conducive to the emanicipation of man, it soon came to be questioned.

Empericism gained hold in the ensuing period. The art of metallurgy, mechanical engineering, navigational aids, clocks and instrumentation received an impetus. People set our to explore the limits of earth. New lands were discovered. Weapons of war were perfected. Medical sciences become more in tune with the physiology of man.

With Descartes, rationalism once again was revived when he proposed the reduction of diversity of external reality to pure quantity and philosophy to mathematics. The success of Newtonian mechanics and calculus provided the essential framework for description of physical systems. By now man became more earth-bound, he was more open, less inhibited. His dignity could only be maintained by human effort.

In this context the synthesis of mathematical rationalism and the experimental method heralded the scientific revolution of the 16th Century and the industrial revolution of the 18th century with untold excitement in the proliferation of inventions and discoveries.

The remoteness of the possibility that major technical improvements will be hit upon by chance was sufficiently stressed by Francis Bacon. This is especially true in the areas of machinaries, materials and energy sources. It became clear that the design of machinery unaided by theory leads to products that are clumsy, inefficient and slow. Analysis of action of machines is essential to the realization of its full-potentials. Refinement in machine technology also relies on materials and energy sources. Both require knowledge of sciences for their development. Further the nature of certain products is such that trial and error cannot lead to a mastery of the technique. Empericism can culminate in a Ming vase but not in a plastic cup.

The late eighteenth century was the point in time at which the curve of diminishing returns from pure empericism dipped to meet the curve of increasing returns from applied sciences (Hall 1963). But the end of nineteenth century still saw the black-smith as a mechanician and an engineer. However the road definitely led to scientifically minded engineers like Watts, Parsons, Marconi and Edison.

Mere hard facts of science cannot lead to a light lamp or a wireless set. It requires an Edison or a Marconi to relate a remote scientific possibility to a social need. It requires a creative thinker, somebody who is imaginative or far-sighted, a productive dreamer. A person who can look at an idea from many viewpoints and consider the problem in a larger perspective. Such people are remembered as visionaries and seers. We are back to metaphorism, for only this epistemic mode when coupled to rationalism and empericism can lead to an original or creative act.

Metaphorism as the epistemic style of artist had another important role to play in the history of industry when in the nineteenth century it was called upon to mass produce items for public consumption. The objects had to be not just objects of utility but also a symbol, for man lives in a world not of things but of symbols (Bertalaffy 1967). From the earliest of times people have vied in their ownership of work of craft as much as they did in their works of art. This was not because the poet, painter and sculptor were craftsmen of a sort, but because the blacksmith and the glass-blower were weighed in the same aesthetic balance. Until our dismal age of camouflage, fighting men have always decorated their equipment, the pennons on lances quickly took on colour and design. A lance was too long to be carried into a tent conveniently, so a knight usually set it upright outside his tent, and if one were looking for him one looked for the flutter of his familiar pennon. Knights riding horses held their lances erect, and since their increasingly massive armour made recognition difficult, each case had to be identified by his pennon. Perhaps from the pennon that distinctive “connoissances” were transferred to shield and surcoat with the crystallization of the feudal structure, these heraldic devices became hereditary symbols of status in society.

Similarly in the Victorian Age, Hick and Son sought to evoke the majesty of the Age of Pharaohs' by designing a hydraulic press in a neo-Egyptian style (deemed appropriate then to the serious business of manufacture).
Such surface inlays and overlays of the Victorian period were not suitable to mass-production techniques then, the simplicity of the colt revolver was a dramatic contrast. Not that the components were produced many times faster than what the human hand could fashion, but the parts could be produced with sufficient precision to make it interchangeable with the same part from another unit. There was another way in which successful quest with the flying machine. The success of Wright Brothers was not so much to some yet unused law of mechanics or aero dynamics. It was essentially due to the use of man as a control system that provided the necessary feed back for stability. The same has been referenced by Iberall (1972).

In the survey of 6000 years of design we also find that concepts underlying controls and systems played an important role in the construction of pyramids, planning of Mohenjo-Daro and Harappa, construction of Taj Mahal would not have been possible. However as far as engineering as a discipline is concerned there is an underlying development from structures, machines to controls.

Ships, buildings, bridges, chariots were essentially structures. It is with flour mills, pumps, lathes that the concept of transformation of energy, motion and mechanical advantage became important. This was especially so, sixteenth century onwards. In the nineteenth and twentieth century with the advent of bicycle, automobile, aeroplane and automation etc., controls became a challenging engineering field. Today we are interested in

'Empiricism can culminate in a ming vase but not in a plastic cup'

systems: communication, man-machine, machine-culture, industrial, etc. As a matter of fact the increased complexity of the modern socio-economic and technological enterprise demands that even the smallest of the products should be designed from the systems viewpoint.

Design now has ceased to be a one-man's show, it needs team effort to consider the myriad of factors it must embrace and the myriad of forces it will generate.

The teams have to be transdisciplinary so that information from various disciplines and epistemic styles of exploration and expression can be coordinated towards the unification of the design act. This coordination of people working in diverse laboratories and studies has to be such that their egocentricism transcends professional centricism to nucleate into a product-culture centricism.

The task requires design managers, who are essentially managers of talented people, operating at various levels. The number of levels will depend on the complexity of products systems and extent of innovation desired. The necessary coordination can be provided by generalists who have an appreciative and critical understanding of the various epistemic styles. They will have to holistically and humanistically integrate design effort. Their concern with product and its relationship with the culture of use, will be par-excellence.

There are many private undertakings that are involved in this type of effort. Bell-laboratories in the field of communication and Polaroid Inc. in the field of photography are just two examples.

Industrial Designer, by virtue of his concern with product quality especially with regard to its relationship to consumers and production requirements is a hopeful contender. However, he is likely to find the task of managing engineering and science specialists a challenging task. World-wide it is still open to debate as to what would constitute suitable qualification of design managers. We shall not go into details of same here.

Since we are drawing insights from history it is essential that our strategy should be able to cope with the survival of the product, enterprise for a historically significant period of time. No product, no matter how excellent its performance characteristics, can survive for long unless it is consistent with the cultural policies and takes the culture in a direction that may be, historically found to be viable and evolutionary to the emancipation of man. Design managers thus are not just managers of product but also surveyor of culture. They must reflect on the relationship of culture vis-a-vis product. There are thousand and one products each produced a million times. Together they constitute a significant and important aspect of culture. Mistakes cannot be camouflaged for time will reveal them.

The only solution is that we shed our misplaced inhibitions and mobilize our resources of man, material, information and insights towards pursuit of design excellence.

By design let us mean "DOING A JOB AS WELL AS IT CAN BE DONE". Let us leave no possibility unexplored in our quest for the infinittude in holistic advantage.

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KEY WORDS: epistemic style, trans-disciplinary management, Design definition, cultural evolution, General System Theory. ■

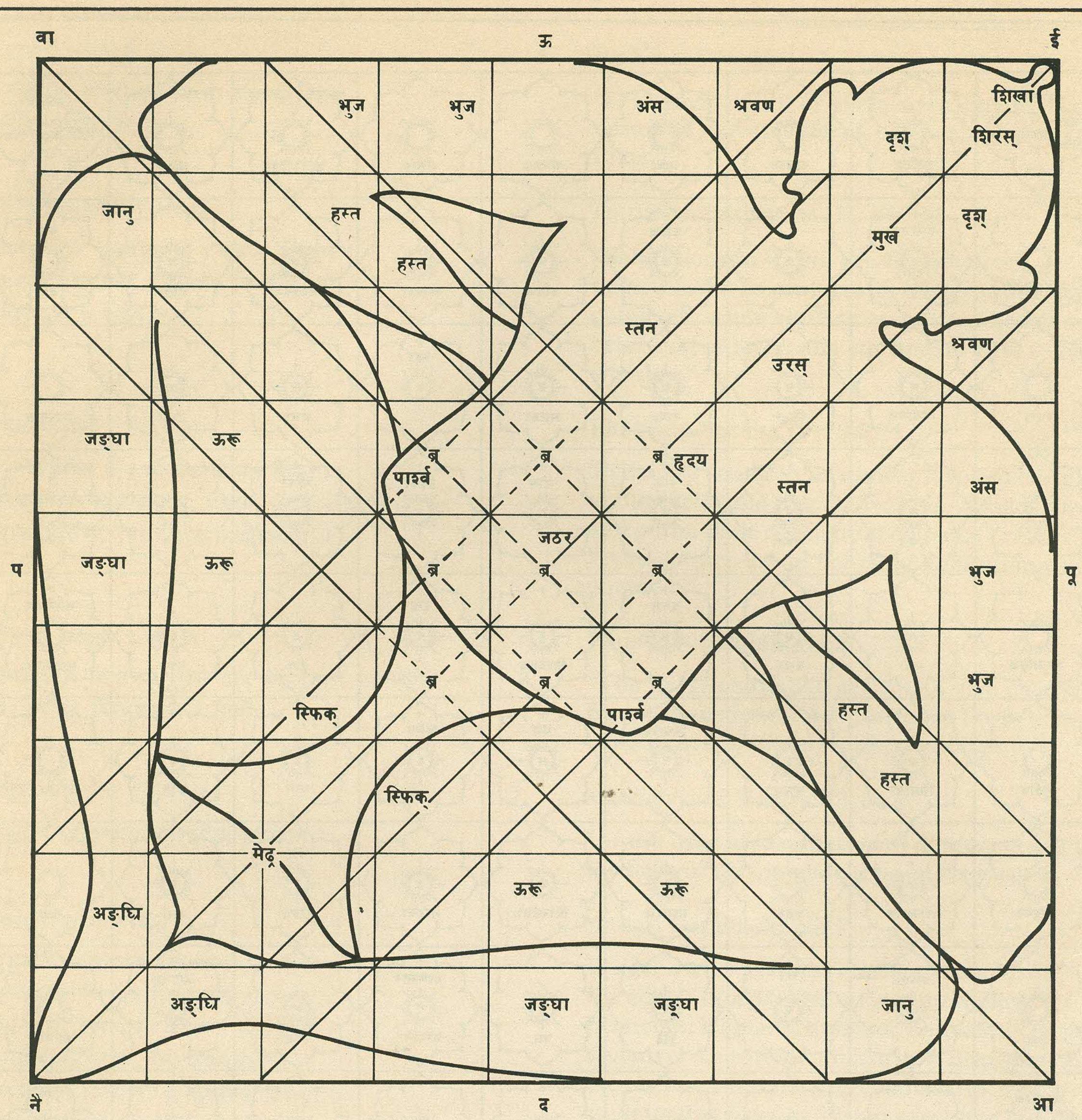
DESIGNING OF FORM FOR VASTU-DEVATA

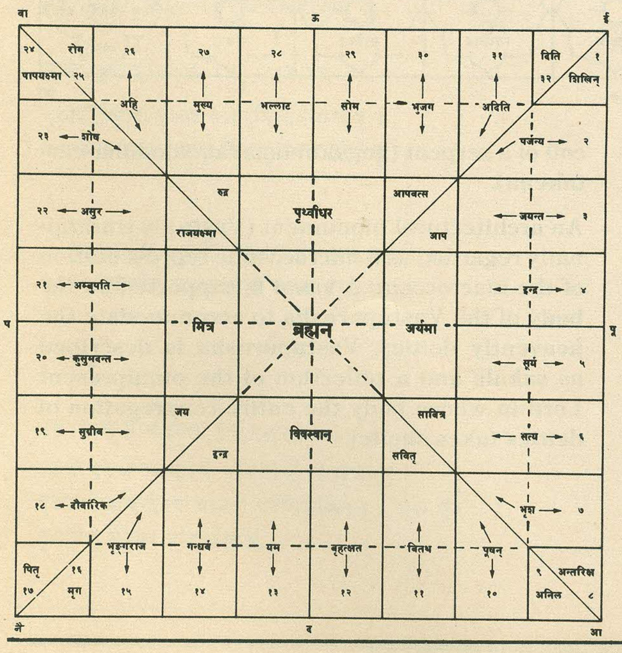
Dr. Prabhakar Apte

The concept of human residence being protected by some divine agency finds its origin in the Rgveda. Vastospati, the Rgvedic deity, presiding over human dwelling is identified with Rudra in the Taittiriya Brahmana and prayers are offered to Him because He protects the dwellers in all activities connected with their residence. The Pauranic tradition informs us that the Earth came to be called Medini since it was produced out of the fat (= meda) of the demons Madhu and Kaitabha slain by Lord Visnu. The earth later on came to be known as Prthvi when its surface was levelled (√prath = to flatten) by King Prthu. Prthu is said to be the founder-architect of human habitation: both urban and rural.

It was perhaps the devotionally oriented class of architects who conceived the divine protector of residential area in human form to be fitted in a frame of a geometrical diagram which was later on known as Vastu-Purasa-Mandala. The instructions regarding the details of sketching the Vastu-Mandala in literature, are for the first time, recorded in the Pauskara Samhita (c. 300 A.D.), of the Vaisnavite Agamic tradition, Matsya - Purana (- 500 A.D.) of the early - Puranic stock and Brhatsamhita (c. 500 A.D.) of Jyotisa tradition. The concept of pervasion of Vastupurasa reaches its culmination in 'Samarangana-Sutradhara' of King Bhoja (11th c. A.D.) where it extends to the entire area of houses, places, temples, tanks, military camps, forts, villages, townships and the linking roads. The anatomical form of the Vastupurusa to the shape of the respective ground plans : square or rectangular, round or semicircular, triangular or hexagonal etc. There are various legends telling about the association of Vastupurusa with building sites. According to Matsya Purana, He is a ghost spirit formed out of the sweat of Lord Shiva on slaying of Andhakasura. This blood thirsty Bhuta, was not satisfied with Andhakasura's blood, set out to devour all the three worlds on getting a boon from Shiva. He was seized and trapped by Gods, demons and others on the surface of the earth. Gods gave him food in the form of Vastubali offered to Him on various occasions. He was assured that the defaulters and their construction would fall pray to the hunger of Vastupurusa. Our ancient tradition developed the elaborate sketch of Vastumandalas for offering worship to the divine protector. Consequently this topic has been an integration of religious, astronomical and architectural background. The study of the structure of these diagrams has developed into an independent branch.

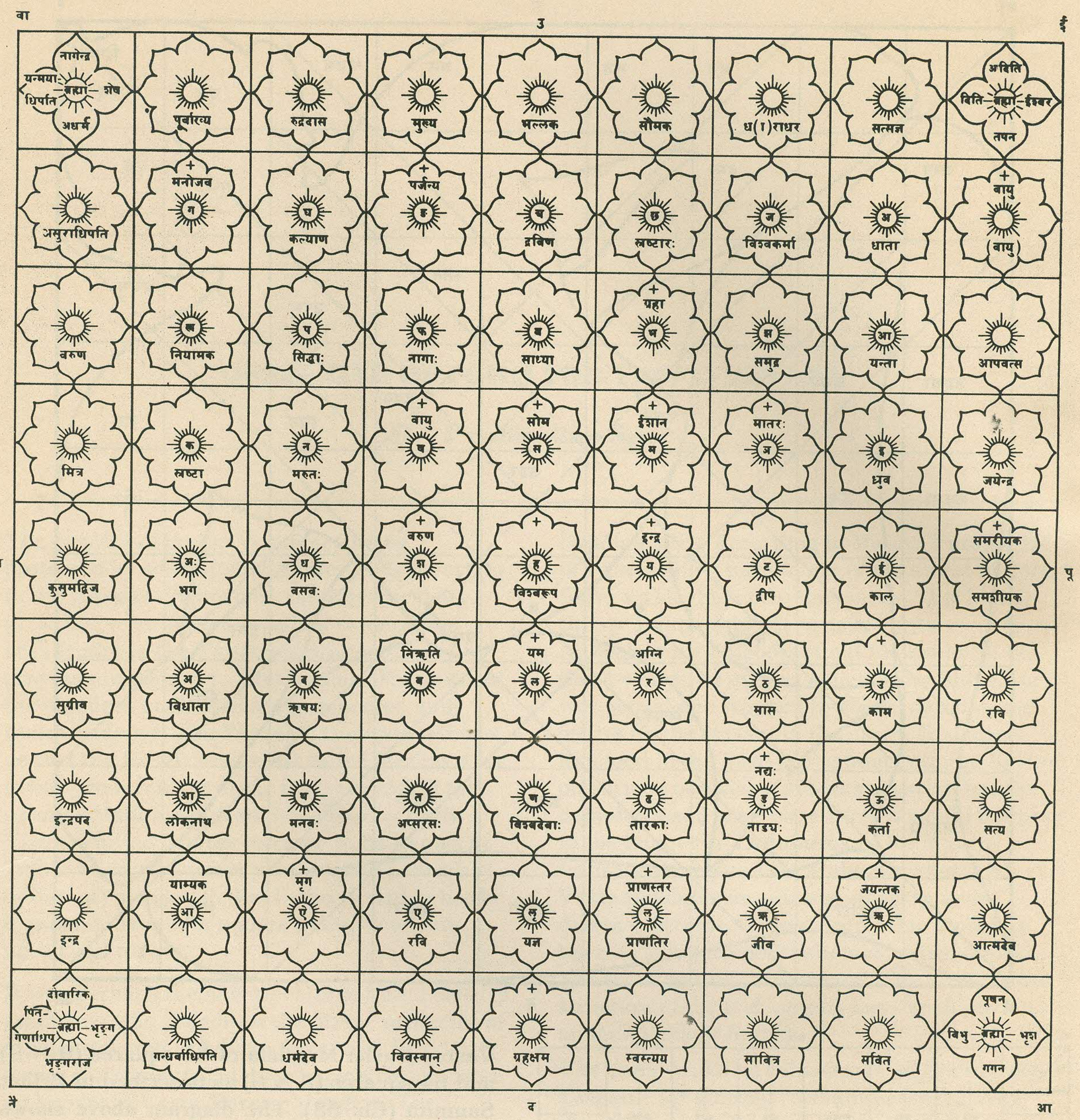
The early works on Silpasastra proper are not available for quoting relevant passages even though a list of eighteen Vastu-Sastrajnas is furnished by Matsya Purana. Here we give some select Sanskrit passages with English rendering to show a broad outline of the Shastric nucleus from which multiple design patterns of ground plans emerged in Ancient times.





Vastupurusha Mandala of 81 squares (9 × 9) and 64 squares (8 × 8) as described in Brihat Samnita (Ch. 53). The diagram above shows the Vastu-purusha drawn with all the limbs, and the diagram on the left the presiding deities of the various squares. In the centre of both the diagrams, the presiding deity is Brahma.

Parjanya and the like occupy the eyes, the ears, the chest and the shoulder; Satya and other five: the arms and the hands; Savita, Savitra, Vitatha and Brihatkshata - the back; Visvasvan-stomach; Yama and others occupy the thighs, the knees and the buttocks. These are on the right side. The left-side-parts are occupied by the other corresponding deities. Indra and Jayanta occupy the private part; Brahma occupies the heart, and the Pitris occupy the feet.



Vastupurusha Mandala of 81 squares (9 × 9) from the Paushkar-Samhita. All the squares contain lotus designs. Four of them in the four corners have four petals and the rest have eight petals. The central square is allotted to Lord Vishwarupa. Brahma occupies all the four pericarps of the lotuses in the corner squares and each petal accommodates one deity. Rest of the squares contains one deity each.

Each of the inner enclosures possesses a syllable (matrika) in addition to the presiding deity. The allocation of these syllables commences with the N.E. corner of the second (inner) enclosure of 24 squares and ends with the central square and accommodates 49 syllables from 'a' to 'h'. The direction is clockwise and like the coil of a serpent (nagakundalavat dakshina-vartakena).

An architectural monument (Vastu) is traditionally regarded as a microcosmic representation of the macrocosm. A vastu is supported on the body of the Vastupurusha to accommodate the heavently deities. Vastupurusha is described as sakala and a reflection of the omnipresent Lord in whose body the entire congregation of deities takes shelter.

ऋग्वेद ७,५५.१	Rg Veda VII. 55.1
अमीवहा वास्तोष्पते विश्वा रूपाण्याविशन् । सखा सुशेव एधि नः ॥	"O Vastospati, killer of diseases, having assumed universal form, be an auspicious friend to us".
तैतिरिया ब्राह्मणा ३,७,९.७	Taittiriya Brahmana.III. VII.9.7
नमो रुद्राय वास्तोष्पतये । आयने विद्रवणे । उद्याने यत्परायणे । आवर्तने विवर्तने । यो गोपायति त ँ हुवे ।	"Salutations to Rudra the Guardian of homestead who protects us while coming in or going out, while shifting or quitting house, while returning or internally shifting; to Him I offer worship."
भागवत पुराण ४,१९.२९	Bhāgvata Purāna IV.19.29
भूमण्डलमिदं वैन्यः प्रायश्चक्रे समं विभुः । निवासान्कल्पयांश्चक्रे ... ग्रामान् पुरान् पत्तनानि । प्राक् पृथोरिह नैवेषा पुरग्रामादिकल्पना ॥	'Prthu the son of Vena almost levelled the globe of the earth; and having founded villages, towns and ports, built residential colonies ... Prior to Prthu neither urban nor rural habitation was planned."
पौष्कर संहिता ३.५८	Pauskara Samhitā 3.58
पूजनीयश्च विधिवत् पुरुषो वाथ संस्थितः । छायोत्थो यः पुनर्विप्र विश्वरूपस्य वै विभोः ।	"The Person situated on the site who emerges from the shadow of All-pervasive Lord, is to be worshipped in the prescribed manner."
महानिर्वाण तंत्र १३.४२.१	Mahānirvanā Tantra 13.42.1
देवतानां प्रतिष्ठायां वास्तुदैत्यं प्रपूजयेत् ।	"At the time of installation of deities, Vastu in the form of demon should be worshipped"
मत्स्यपुरान २५३.२-४	Matsya Purāna 253.2-4
भृगुरत्रिः वसिष्ठश्च विश्वकर्मा मयस्तथा । नारदो नग्नजिच्चैव विशालाक्षः पुरन्दरः ॥ ब्रह्माकुमारो नन्दीशः शौनको गर्ग एव च । वासुदेवोऽनिरुद्धश्च तथा शुक्रबृहस्पती ॥ अष्टादशैते विख्याता वास्तुशास्त्रोपदेशकाः । संक्षेपेणोपदिष्टं यन्मनवे मत्स्यरूपिणा ॥	Bhrgu, Atri, Vasistha, Visvakarman, Maya Narada, Nagnajit, Visataksa, Purandara, Brahman, Kumara, Nandisa, Saunaka, Garga, Vasudva, Aniruddha, Sukra and Brhaspati are the eighteen teachers of Vastusastra, which was explained in brief by Fish incarnation of Visnu, to Manu."
मत्स्य पुराण २५४-२१, २२२.४९	Matsya P.254-21, 222.49
एकाशीतिपदं कृत्वा वास्तुवित्सर्ववास्तुषु । पदस्थान् पूजयेद्देवान् त्रिंशत् पञ्चदशैव तु ॥...	"For all site, the expert architect should draw a diagram measuring $9 \times 9 = 81$ units. In all forty five deities should be worshipped occupying various portions."….
...गृहारम्भेषु कण्डूतिः स्वाम्यङ्गे यत्र जायते । शल्यं त्वपनयेत् तत्र प्रासादे भवने तथा ॥	"Whenever at the time of commencement of the construction of the house, the owner has an itching sensation on some part of his body, the corresponding part of the site requires removal of thorn etc."
समरांगण सौत्रधारा १२.२०.२१	Samarāngana Sutradhāra. 12.20.21
त्र्यश्रे षडश्रे चाष्टाश्रे षोडशाश्रे च वृत्तवत् । वृत्तायतेऽर्धचन्द्रे च वास्तौ पदविभाजनम् । एक एव पुमानेषु बहुधा परिकल्पितः ॥	"The division of units is to be made in all kinds of sites: triangular, hexagonal, octagonal or sixteen sided; likewise circular, semicircular, like arc of the moon (in addition to square one). One and the same (Site-) Person is sketch in manifold forms." ■

AESTHETICS OF PROBLEM PERCEPTION - PEDAGOGY OF A CREATIVE ACT

A.G. Rao

Problems are common to all disciplines. In day to day life, every one of us faces problems and often solves them. Practical professions like Engineering or Management are continuously engaged in Problem-solving. Only when we turn to creative fields like Painting or Literature, do problems seem to take a different turn. When one is discovering or creating something new, the nature of 'problem perception and problem solving', in other words 'problem encounter' differs as it touches the boundaries of unknown. The 'aesthetic' nature of such creative endeavours in Art and Science has been well acknowledged by well known Artists and Scientists.

Industrial design is quite often described as a 'problem-solving process' and as a 'Creative activity'. So the problems, problem encounters and their aesthetic nature become an important concern of Industrial Design. In this article I shall first dwell on 'problem' with its widest meaning, focussing on the aesthetic or creative level of problem encounter. Later, pedagogy of such a level is discussed taking the example of 'Cube-bisection' problem posed to graduate engineers and architects as one of their basic design tasks.

What is a problem?

When does one experience a problem?

We may say 'a problem is a state of unrest or conflict in one self'. This state of unrest could be felt physically as a 'body need' or mentally due to the perception of external world. In either case the 'state of unrest' which demands a 'purposive action' (usually called solution) leads to the definition of a 'problem'.

We tend to deal with problems in two stages: problem perception and problem solving. The very gap or time interval between problem perception and problem solving is the genesis of the problem. The gap or time interval is caused by the obstacle, psychological or physical, between the problem perception and problem solving. Suppose I am thirsty, I go to a water cooler and drink water. The problem of thirst is over. There is no appreciable delay, i.e. time-gap, or hindrance between problem perception and problem solving. One may say there was 'no problem' in this case. On the other hand, if I am thirsty and the water is dirty then a 'problem' emerges as to how one can make water potable or get clean water from else where. At times solution to one problem may cause other problems. If water is to be boiled or distilled on a large scale to make it potable, it may cause fuel-shortage and may subsequently lead to the cutting of the forests, which in turn causes ecological problems. The recognition of water being dirty may be due to the reason it 'looks dirty' or we 'know that it has some disease-causing germs'. In either case we have certain pre-experience or knowledge i.e. we have seen clean water before or we have used water free of germs. Thus when we perceive the problem we have already considered a state where the problem has been solved. In effect 'problem perception' which leads to 'problem definition' has already absorbed the solution of the problem in varying degrees. The quality of problem-resolution i.e. 'satisfactory purposive action' in response to the unrest or conflict, depends on the level of problem perception. We can observe three levels of problem perception.*

1. Biological or physical level
2. Knowledge or specialisation level
3. Aesthetic or creative level

* There could be a fourth level which may involve extra sensory perceptions which I shall not touch upon here.

1. Problem perception at Biological or Physical level

This level of problem perception is based on our physical and biological needs, which we recognise internally. If I am hungry, I perceive the problem of getting food. If the room I am sitting in, gets hot and stuffy due to power failure, I look for the means to get fresh air and so on. This level of problem perception is common to us and other living beings like animals and birds.

Problems, at this level are physically felt and are not a product of our acquired knowledge.

Animals and insects whenever there is a threat or obstruction to their natural course of action, recognise 'the problem', which they try to solve according to their intelligence level. Scientists have been successful in setting problems to even earth-worms which the earth worms solved after over 100 trials. In an animal with higher intelligence, like chimpanzee all the steps from problem recognition to solution namely Preparation, Incubation, Illumination and Verification have been observed by scientists[1]. This level of problem perception which we seem to have inherited from our animal ancestors is basic to our physical existence.

2. Problem Perception at Knowledge level

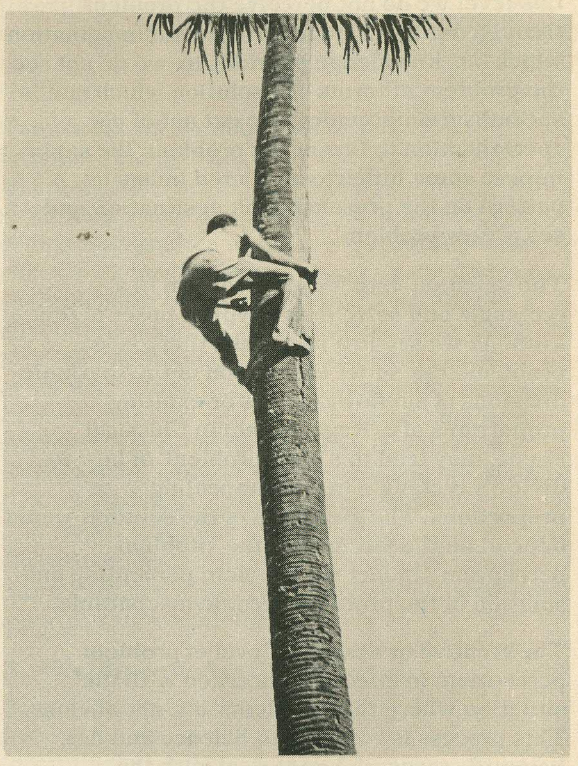
The knowledge level of problem perception takes place because of the person's knowledge: education, training, cultural or ethnic background, etc., in short 'one's conditioning'. At this level of problem perception one looks through his/her conditioning, knowledge or specialisation. Let us see how this level of problem perception takes place in case of 'palm-tree climbing' in India.

People climb palm trees to tap palm-juice, which oozes, when cuts are made on the top portion of the tree. The juice is collected, once in a day or two days and fresh cuts are made to ensure the flow of the juice. Palm-juice called 'Neera' is drunk fresh or 'Gur' - a kind of sugar is made out of the juice. Sometimes alcoholic liquors are distilled illicitly out of this juice. Palm-trees are 20 to 30 feet tall. Climbing them is rather unremunerative, risky and demands skills. There are atleast 2 to 3 million palm trees still untapped in India.

Traditionally a small community of tappers climb the trees. They perceive no problem in their task. But if we were to pose this problem situation to different professionals, they all would perceive the problem in different ways.

An economist in 'Planning Commission' would look at it as a problem of unemployment and low wages. An ergonomist may see it as a problem of safety for the climbers. A machine designer may perceive the problem as that of designing a tall fork-lift which can move in the uneven terrains. A botanist may think of the problem as how to grow a dwarf variety of palm-tree to eliminate tree-climbing. A chemist may see it as a problem of oxidation and coagulation at the cut which necessitates the reopening of the cut every day. Otherwise juice can be collected below, by connecting a tube from top to bottom. Some specialists may reject the problem altogether. A musician may consider this as a technical problem which is not of his concern.

In effect, every specialist, who recognises the problem, perceives it in terms of a solution which could have been used in this case, but could not solve the problem fully. Thus the economist would recognise the problem because the wage increase of 'farm - workers' has increased the employment of the unskilled; but in this case unskilled cannot be employed. The ergonomist may see the problem because a standard safety belt which is a known solution to him is inadequate here. Similarly the botanist knows that dwarf variety of coconut tree has been successfully cultivated, but such a variety does not exist in palm-tree, so he/she recognises the problem. Similarly the chemist may be seeing the problem in terms of a similar solution which has been successful elsewhere.



Thus all successful solutions in any field become the specialist's knowledge. And the specialist looks at the new situation through this knowledge i.e. some known solutions. If it is directly applicable he may just recommend the solution and his interest in the new problem situation may be lost. In fact, as the psychologist Kurt Lewis[2] has shown, we do not become emotionally involved in either a task too easy or in one that is too difficult, but only in tasks we can manage our best.

Each one of us tends to be a specialist in some sense and this specialisation or narrow knowledge limits our problem perception to this uncreative level. Even, a scientist of specialised knowledge, and a nobel laureate, Konrad Lorenz cautions, "The specialist comes to know more and more about less and less, until finally he knows everything about mere nothing. There is a serious danger that the specialist, forced to compete with his colleagues in acquiring more and more pieces of specialised knowledge, will become more and more ignorant about other branches of knowledge, until finally he is utterly incapable of forming any judgement on the role and importance of his own sphere with in the context of human knowledge and culture as a whole".[3]

3. Creative or Aesthetic level of problem perception

The third and an important level of problem perception is the creative or aesthetic level. At this level we do not perceive the problem through our knowledge but through imagination which our knowledge provides ie. we do not see the problem in terms of a solution which our specialisation provides. We get out of our specialisation to invent the problem. We super impose some hitherto unrelated image or pattern on the present problem situation and see a 'new problem'.

The question like 'Pose a problem in a rectangle and solve it' is a typical poser of this kind.[4] As we see in a rectangle, there is 'no problem'. But super imposition of the rhythmic divisions of sunflower seeds or exalting proportions of a 'Raga' in Indian Classical Music, may lead to a 'new problem' of how to divide a rectangle in such appealing proportions. The greatness of the solution would depend on the strength of the 'problem perception'. In fact the problem perception and solution of the problem become inseparable.

The creative or aesthetic level of problem perception, in effect is concerned with the situation where the 'problems' are not obvious. This process is common to Science and Art. Scientific research has to deal with the unknown, where the 'problems' have to be discovered and Art's major concern is creating the new. Aesthetic process in Art is unquestioned. The aesthetic nature of Science, especially in the creative phase is emphasised by many leading scientists time and again. The famous physicist Bruno Russi[5] states, 'An intuitive feeling for the order and the simplicity underlying natural phenomena is as essential to the creative scientist as it is to the creative artist, for to discover a scientific truth is merely to reveal some new aspect of the armory of nature'. We observe this aesthetic bias to be in greater strength when we look at the comment made by another famous scientist, Heisenberg to Einstein .

'You may object that by speaking of simplicity and beauty I am introducing aesthetic criteria of truth, and I frankly admit that I am strongly attracted by the simplicity and beauty of the mathematical schemes which nature presents us. You must have felt this too: the almost frightening simplicity and wholeness of the relationship, which nature suddenly spreads out before us....'[6]

Scientists seem to have used the aesthetic notions like simplicity, order and cleanliness with 'vehemence' in judging new theories or works of science. Cognitive psychologist, Prof. Gruber who studied Darwin's thinking process in great detail points out how these limited notions of aesthetics have dominated scientists' thinking. 'For a long time nothing so offended the aesthetic sensibilities of many scientists as the suggestion that the world was not perfectly orderly. When Herschel disdainfully described Darwin's theory as the 'law of higgledy piddledy', this was not only an intellectual objection to the introduction of chance into a scientific theory but an aesthetic reaction as well. This is clear from Herschel's other remarks'[7].

Gruber's further remarks elaborate the third level of problem perception. 'When we consider the scientists' thinking, we cannot escape the aesthetics of complexity. As we come to understand the intricacy of the course of thought, some of us admire it and find it all the more beautiful. As we see its unfinished character and the struggles of the scientist with a task which is inevitably and tragically beyond his grasp, other aesthetic values come to the fore. There is little prospect that our picture of creative thinking will grow simpler in the near future. We have just begun to uncover its seductive labyrinths'.

We see similar views expressed on the creative process of Art, by artists as well. In fact the disorder and destruction of existing imagery in the creative process is evident when we look at the statements of Paul Valery or Picasso .

'For the fact is that disorder is the condition of mind's fertility: it contains the mind's promise. Since fertility depends on the unexpected rather than the expected, depends rather on what we do not know. How could it be otherwise?' questions Paul Valery.[8]

'When one begins a picture one often discovers, finds things. One ought to beware of these, destroy one's picture, recreate it many times.

On each destruction of a beautiful find, the artist does not suppress it, to tell the truth, rather he transforms it, condenses it, makes it more substantial' – said Picasso in his conversations with Christian Zarvos.[9]

Thus the creative or aesthetic level of problem perception implies a deep emotional involvement of the Artist or Scientist. And in his/her bewilderment of this encounter with the unknown, invariably the aesthetic values come into the fore.

The metaphoric super imposition of images has great part to play in this process of problem perception, Brownowski, in one of his talks tells us how Keppler came to the notion that masses attracted each other. He was influenced by a neo-platonist called Nicholas of Cusa who thought that all the matter in the World attracted each other. Nicholas of Cusa in turn has taken the idea from a 5th Century imposter who said 'God's love is universal, it infuses the whole Nature and it therefore infuses every piece of matter. And therefore not only does God's love draw every piece of matter to him, but every piece of matter must be drawn to every other piece'.[10]

Based on Darwin's use of five images (a tree, tangled bank, wedging, war and artificial selection), Gruber points out that every creative individual makes use of such images of wide scope. "An image is 'wide' when it functions as a schema capable of assimilating to itself a wide range of perceptions, actions, ideas. This width depends in part on the intensity of the emotion which has been invested in it, that is, its value to the person".[11]

Problem Solving:

We have seen the 3 levels of problem perception.

Similarly we can observe three levels of problem solving as well namely;

1. Physical level of problem solving
2. Knowledge level of problem solving
3. Creative or aesthetic level of problem solving

1. Physical level of problem solving

At this level we solve problems through physical action. For example if I feel thirsty I walk to the nearest tap or cooler and drink water. We inherit this level of problem solving trait from animals. Though we make use of knowledge in the form of past experience, the basic behavioural pattern in solving the problem is akin to and inherited from our animal ancestors. The abstract level of knowledge which provides the overall view of a situation, is missing at this level of problem solving. The typical situation where we can see this level in operation is in case of a traffic jam. Every vehicle rider tries to go through at the same time. We try to use the physical strength and quickness as a means to solve the problem, which is akin to animal behaviour. In effect, we restrict our view to our own conflict in solving the problem. We fail to see the overall picture, even when our particular way of solving the problem is actually enhancing the conflict situation.

2. Knowledge level of problem solving

We solve a problem at this level, by making use of our specialised learning or acquired knowledge. The knowledge here is not merely experience based as before, but developed on our ability to use abstract concepts. Suppose we are in a traffic jam, instead of trying to push through and aggravate the problem further, we may use our knowledge of different route which may not be known to others, and get out of the traffic jam.

Knowledge level enables us to solve the problem through the particular specialisation which we have acquired. Thus a problem of heat in Summer, may be solved by an architect by designing a shelter which has a natural venturi effect, by a mechanical engineer by designing a special cooler or fan, by a textile engineer by developing a special ventilating cloth to wear, by a food-technologist by developing a cold drink which may help us to counter the heat and so on .... Thus we see that the knowledge level enables us to solve the problem in a fashion which others without that knowledge are unable to do. As pointed earlier in this article, knowledge level due to the narrow specialisation can also set up a mental block due to which we may fail to see simple solutions out side this knowledge.

3. Creative or Aesthetic Level:

At creative or aesthetic level, problem perception and problem solving get intermingled and are sometimes inseparable. Nevertheless an identifiable creative, aesthetic level of problem solving is evident. At this level, four factors, personal identity with the problem, the psychological distance one is able to exercise, ability to superimpose, unconnected images and aesthetic sensitivity seem to be important in solving the problem.

Synectics

W.J.J. Gordon,[12] after extensive studies along with his collegues, on how people invent, has proposed a method which he calls 'Synectics'. Synectics proposes four analogies for creative problem solving.

1. Personal analogy: In using this analogy, the person solving the problem identifies with the problem as if he or she is an element in the problem. If one is thinking of the problem of thirst, the problem solver may think himself/herself as the 'dirty water' and articulate the feelings of the dirty water which wants to get rid of or throw away dirt.

2. Direct Analogy: A direct analogy from an unconnected area, like structure of a tree for designing a shelter, is used to solve the problem in this case.

3. Symbolic Analogy: A 'symbol' instead of an object is used as an analogy in solving the problem. The symbol could be mythical, cultural etc..., while solving the problem of a collapsible jack, Indian rope trick was used as an analogy, which enabled the group to come to a new concept of collapsible jack.

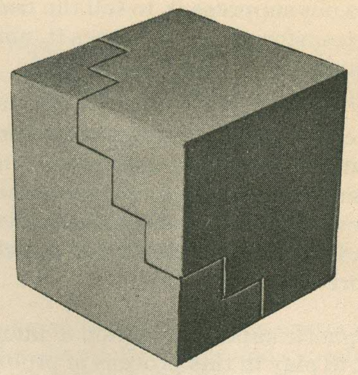
4. Fantasy Analogy: Freud's theory of wish fulfillment is the basis of Fantasy analogy. One wishes abnormal situations or fantasies to solve the problem. Clues to solutions are developed from these fantasies. In solving the problem of a closure, one can fantasise to order a group of insects to stitch across the opening.

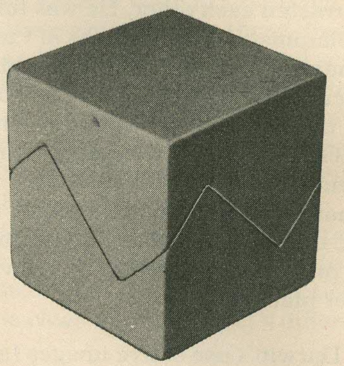
Pedagogy

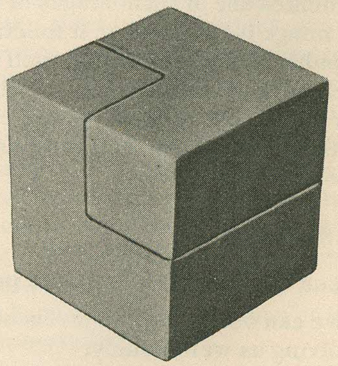
The question of how to deal with the pedagogy of the creative or aesthetic level, is of prime importance to design educators. Traditionally this takes place in design schools at a tacit level. I shall discuss one of the tasks[13] set for graduate engineers and architects at I.D.C.to develop their creative, aesthetic level of thinking. The problem was defined as, "Divide a cube into two identical parts, with a visual surprise as you open it." The word 'Visual surprise' was used to keep the problem 'vague', to some extent. What is 'a visual surprise' was discussed and each student was encouraged to recollect from his/her memory a 'visual image' or a 'metaphor' that has left a strong memory as a 'surprise.' Each student arrived at a different solution for this problem; few are seen in the photographs.

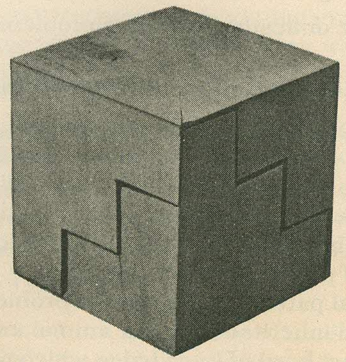
A brief survey with the students a year later on the above problem indicated that many of them had used images like

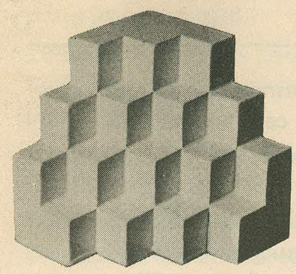
- positive and negative pyramids
- little toy-cubes of different colours which she used to play
- positive and negative black and white masses: temple like configuration.
- steps going up and down

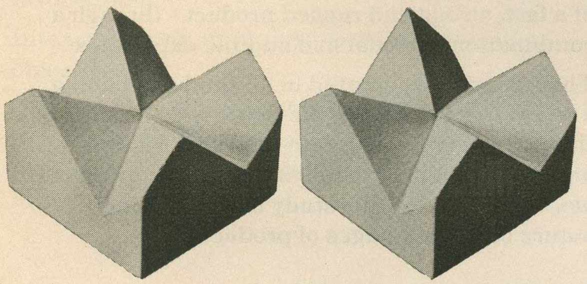


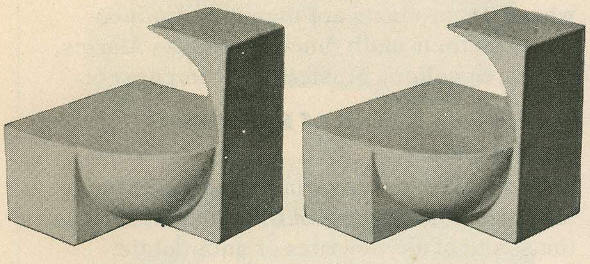


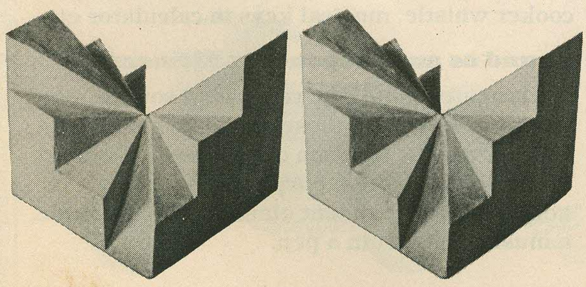












Interestingly, inspite of their strong verbal culture, the students could not articulate their feelings, though they had arrived at interesting three dimensional solutions. All students expressed satisfaction and they were proud of their solutions.

Teacher's discussions with the students, during the task, centred on how to connect their sense of surprise with the aesthetic notions like symmetry, rhythm, continuity and simplicity. The variety of the solutions, considering their back grounds does indicate that the task has helped in bringing out the inherent, individual creative, aesthetic potentials of the students. However the internal processes seem to be subtle and difficult for articulation.

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PRODUCT PERCEPTION THROUGH SOUND

Jayesh Panchal

The consideration of auditory aspects of a product is usually limited to controlling the noise levels, and to ergonomically permissible limits of sound for human beings.

The inherent phenomena of sound to reflect the character of material and mechanism, is widely used to know the correctness of function in products like machines and automobiles - with a wrong sound indicating a malfunctioning somewhere. However, not much attention is paid to the 'Sound Image' of products which is as inherent as the visual image of the product.

With the evolution of new products incorporating a variety of technology and materials, and with the increasing need to enhance the expressiveness of the product, it becomes necessary to control and design sound images to represent internal character of the product through sound as well.

The present understanding of sound can be seen by an example. A lady was asked while operating a kitchen mixer -

'What do you feel about this sound?'

'I can't hear the door bell! she reacted.

'What if something is done to it?'

'It would be nice, but how can you do that?' - she referred to the motor and other working parts of the mixer.

Sound is seen as an inevitable, non-controllable part of the machine; and not as an element which can be designed independently.

The study on 'Product Perception through sound' was carried out by Jayesh Panchal, a postgraduate student in IDC with the guidance of Prof. A.G. Rao - as part of a research project and seminar.

Things are perceived by Human beings through various senses: shapes and colours through eyes, sounds through ears, texture by touch, and so on by other senses.

These perceptions create an image of the product which is a composition of images received through various sensory stimulations. The composition varies with product, time, place and person. Sometimes, sound becomes the dominating stimulus in this composition. For example, a sports motorbike creates an image of a fast, strong and rugged product - through a combination of visual and audible experience.

Though sound is created in all products having a working mechanism, the expressive aspects of this sound as a constituent in product image have not been paid much attention. An attempt has been made in this study to find out the nature of sound images of products.

SOUND IN PRODUCTS

Sound as an element for product images gives the following categories of sound:

- **Sound as the Main Function**
  This category of sound exists in products where the products are meant to produce sound as their main function such as Alarms, Horns, Speakers, Musical Instruments etc.
- **Sound as a Result of Functional Mechanism**
  Sounds which are invariably produced by functional mechanism of the product, such as the sound of a typewriter or automobile.
- **Sound as Communication**
  Sound is sometimes used to indicate operations to be performed by or being performed on the product. For example: milk cooker whistle, musical keys in calculator etc.
- **Sound as an Independent Element**
  In this category all the remaining sounds may be grouped, i.e., all those sounds which do not result from the function of the product, nor are for a communication purpose, but are an additional independent element. For example, a musical gadget in a pen.

THE SOUND PERCEPTION PROCESS

The factors affecting the perception of sound can be classified through various stages of the perception process.

Different materials and mechanisms create their own particular sound which vary with the force applied to them.

In the product as a whole different parts of the product influence the overall sound due to varied configuration and orientations.

The environment affects the sound due to absorbing, dampening or resonating; so also the sound from other products.

The variables in the perception stage can be described with different levels of personal involvement.

Intensity, pitch, mode and duration are quite objective.

The time, previous exposure, analogy and personal attachments are derivatives of personal feelings and are very subjective aspects.

THE STUDY

To study sound perception is to study how different variables affect. The number of variables and their combinations do not permit knowing the effect individually but the pattern can be predicted.

The study basically constituted representation of sound in terms of different adjectives, belonging to three characters of perception.

- **Quality of the sound**

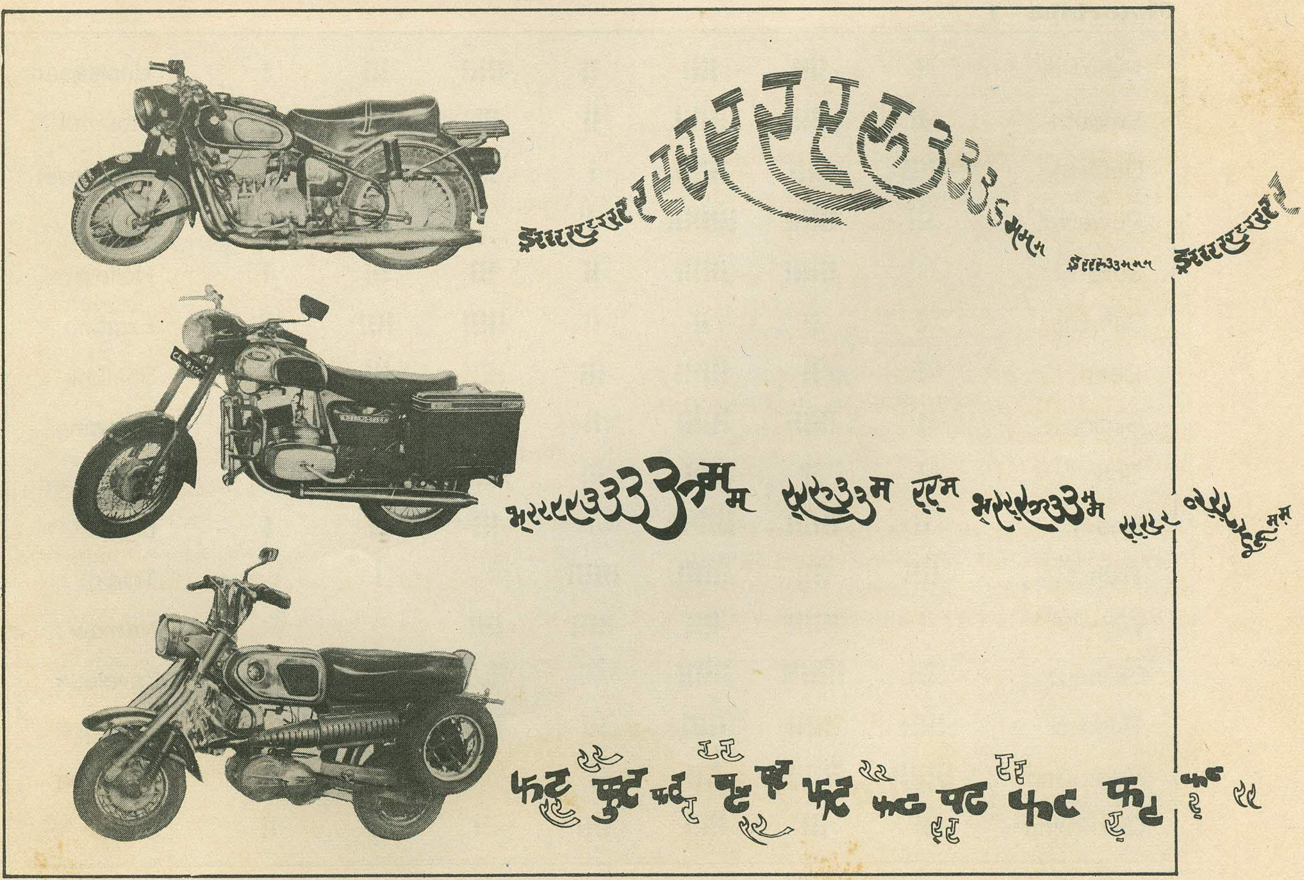
  The adjectives like solid-hollow, wide-narrow etc. define the quality of sound and are quite abstract expressions.

- **Character of the Sound**

  Characters like rough - smooth, rugged-delicate etc. are interpretation of overall image of the product and they also express the perception through other senses.

- **Image of the sound**

  The image of the sound can be expressed in terms of adjectives like powerful-weak, disturbing-quiet etc. depending on personal feelings of the individuals.



Sound illustration: Prashant Agarwal

The sound perception study was carried out on two products: motor cycles and domestic food mixers.

For the motorcycle study, recordings were made of the starting and running sound of three different models of motorcycles. The recordings were played back to subjects, who were then asked to express the sound on a seven scale of a set of 16 adjective pairs.

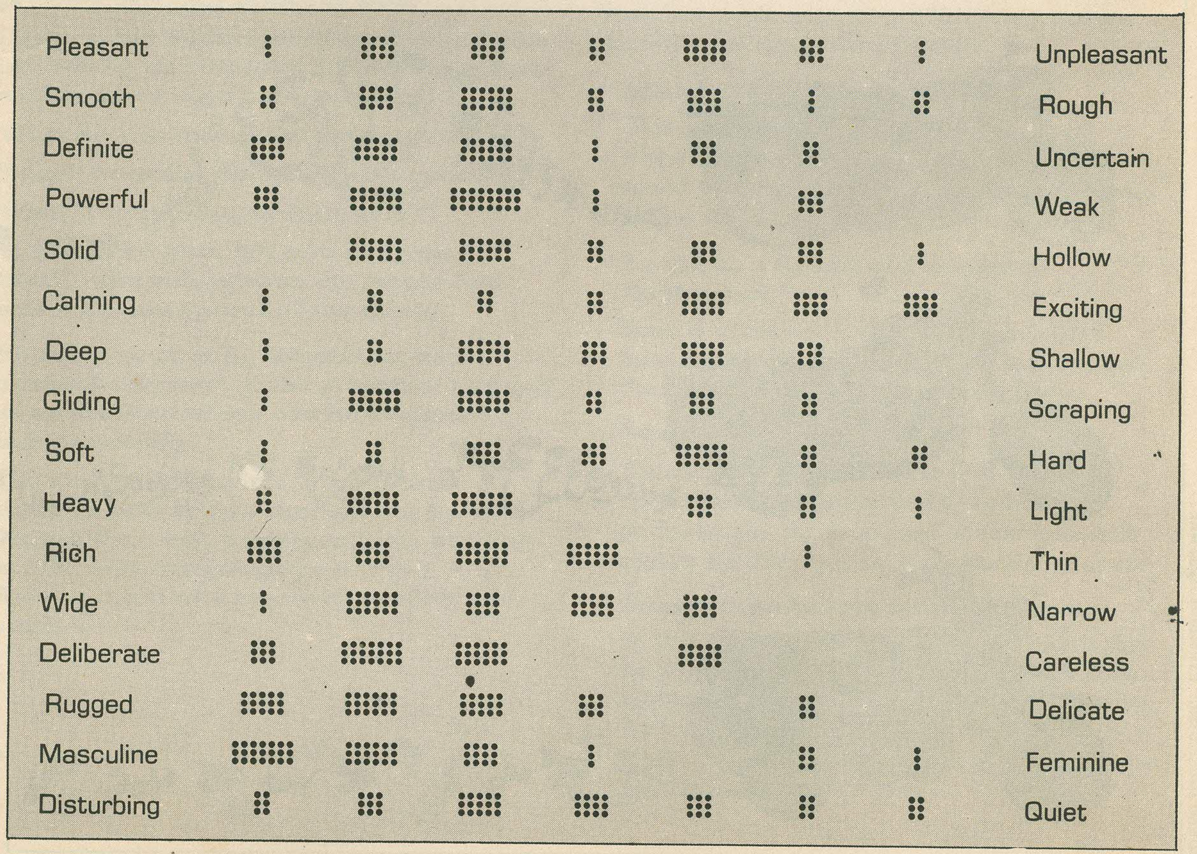
The responses are shown in the chart. Each dot represents one person, so that the number of dots in a particular block gives the number of people who had the same opinion. A verbal sound profile can now be described taking the highest weightage of various characters as follows:

Motorbike 1: Powerful and rich, somewhat heavy but smooth and less disturbing

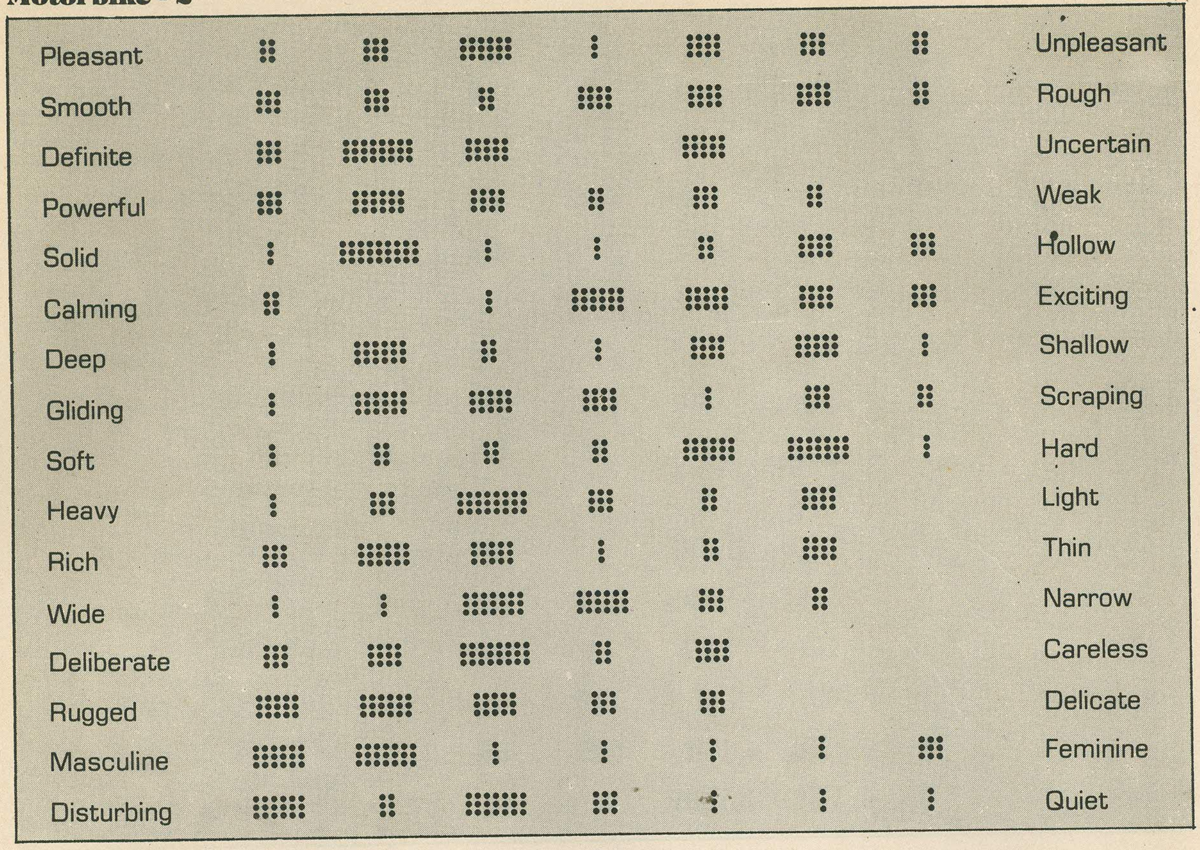
Motorbike 2: Very definite, somewhat powerful, not much heavy but quite hard, rough and disturbing

Motorbike 3: Light, delicate and more towards feminine, somewhat hollow, shallow and disturbing, comparatively weaker.

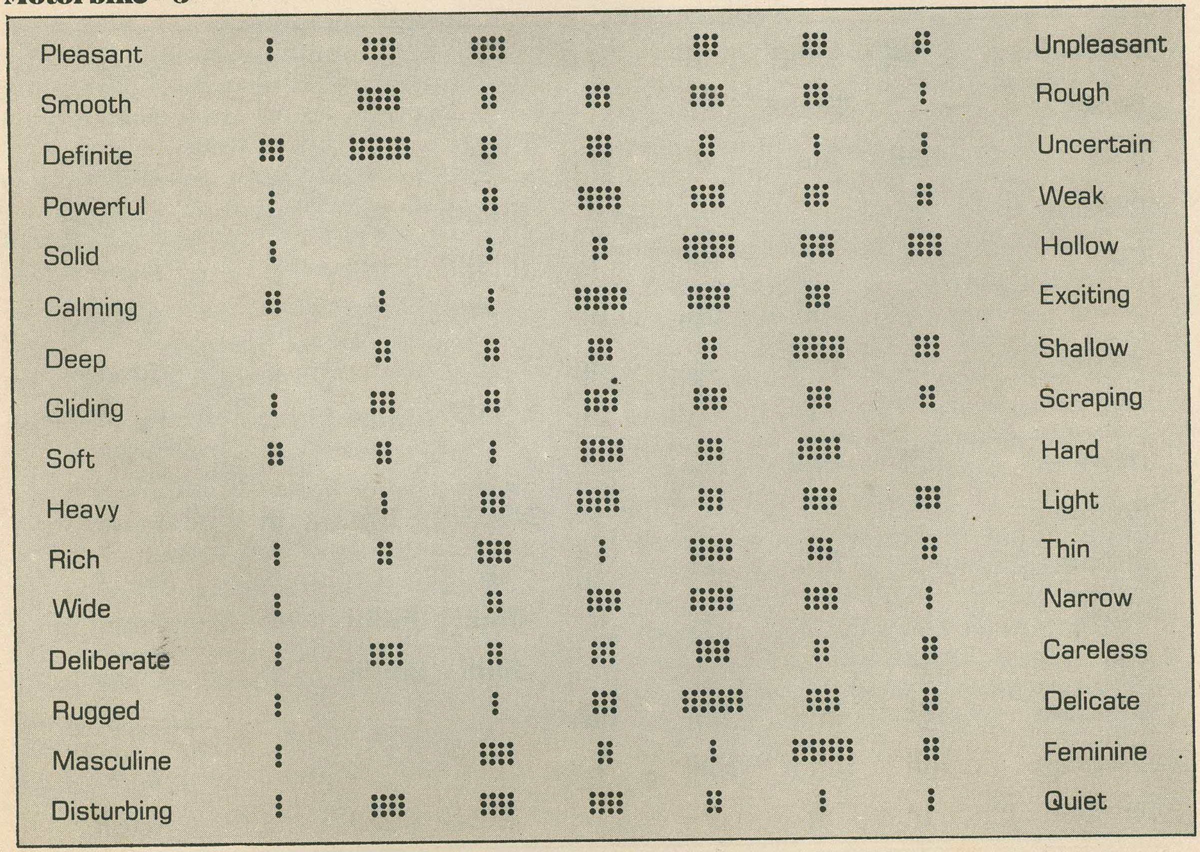
Motorbike - 1



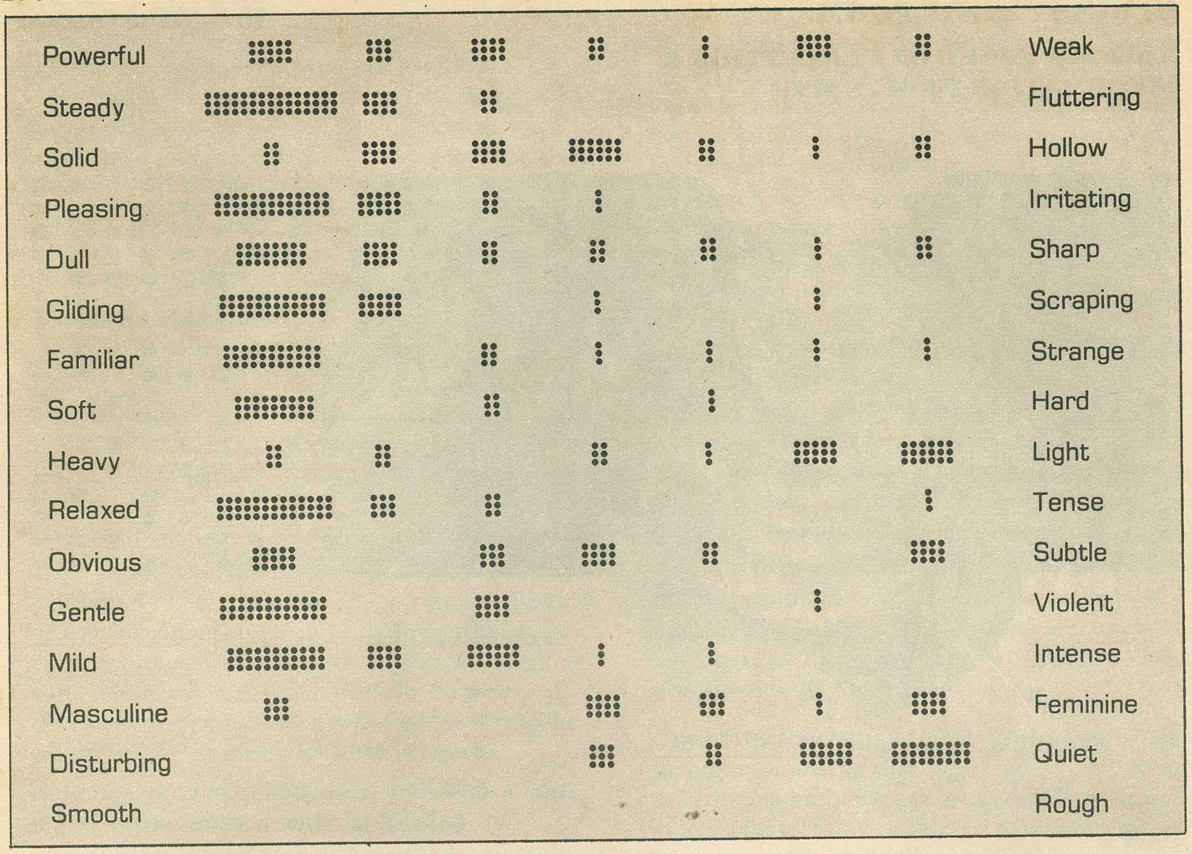
Motorbike - 2



Motorbike - 3



Ideal Mixer Sound



A similar study was carried out - with a different set of adjectives to study the sound perception for domestic foods mixers. The running sound of two mixers were played back to the subjects as before and they were asked to respond to various adjectives on a scale of seven. In addition, they were also asked to describe the type of sound they would like from a kitchen mixer.

The responses can be summarised as below:

Mixer 1: Pleasing and familiar, somewhat smooth and dull but not so powerful

Mixer 2: Powerful, solid, heavy and sharp but more rough, violent, irritating and disturbing.

The desirable sound profile as described by the users for a kitchen mixer can be summarised as: Dull, soft, light and quiet.

The subjects were also asked as to the extra amount they would be willing to pay for a mixer having the right sound, over the basic cost of Rs. 800/-. The sound was valued as worth:

Nothing by 19%;
Rs. 50/- by 47.5%;
Rs. 100/- by 28.5% ;
Rs. 200/- by 5% of the subjects

CONCLUSIONS

It is difficult to draw any definite general conclusions in view of very small number of subjects, however, the study does open up a new point of view for designers.

It was found that subjects had difficulty in interpreting and grading adjectives representing quality of sound, such as wide-narrow.

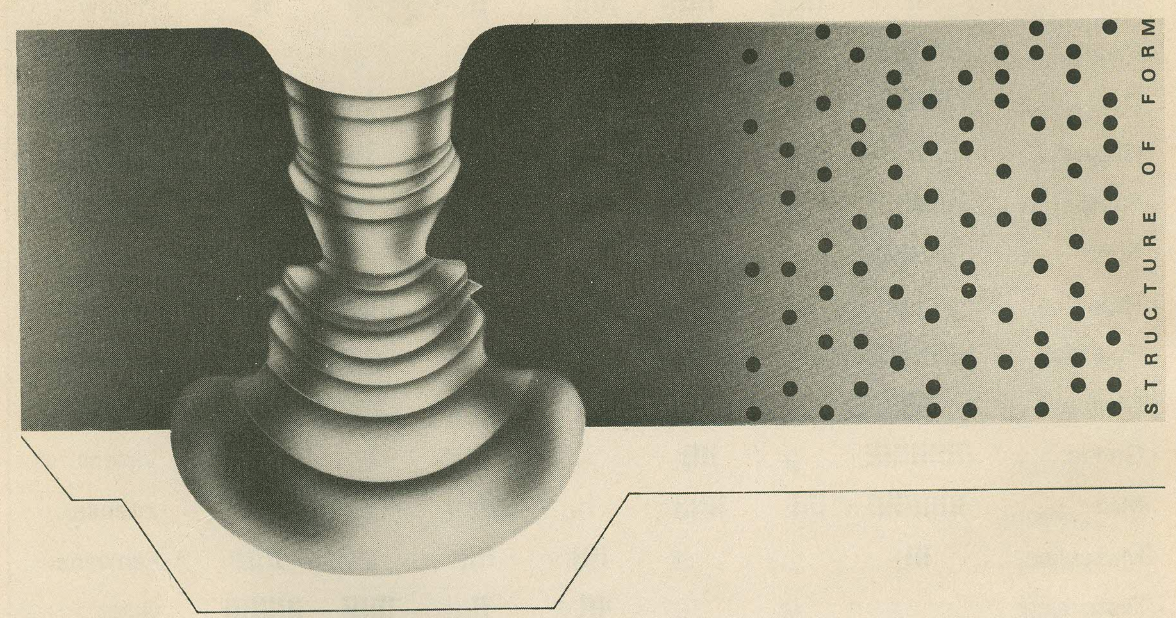
After a sound profile, or sound image is obtained in terms of verbal adjectives, interpretation of results in terms of sound is still necessary. The image has to be analysed to find out the characters which give the image, and the characters have to be analysed to find out the quality (type) of the sound which expresses those characters.

From a designer's point of view, the study opens up the possibility of designing the sound image of the product also, with the same care as is given to the visual image. Sound need not be an uncontrollable byproduct of the working mechanism; but can be positive attribute of the product.

STRUCTURE OF FORM

U.A. Athavankar

A SERIES BASED ON PERCEPTION & INFORMATION PROCESSING



Part 2

Abstract:

The article argues that the visual structure of form, as relevant to communication process is essentially different from the geometry dominated physical structure, useful for its production. Structure that influences communication, should include all qualitative and quantitative relationships, that are likely to influence information transfer.

The article begins by discussing the significance of learning to chunk parts of the message into larger units, to increase information transfer. Evidence is presented to suggest that chunking or unitization is an essential step in processing complex visual input and it is based on the perception of structure i.e. the available relationships in the parts of the message. Gestalt principles of organization are viewed in retrospect, as dealing with structure of visual units, and interpreted as supporting the unitization process. Using relationships as a basis, a more abstract representation of structure of patterns is attempted.

In our last article we tried to build a case to look at the form of the object from an alternative view point: as a message or information being perceived and processed by a human observer. We also found out that in such a communication process, structure of the message, plays an important role.

We broadly defined structure as totality of relationships in a set of elements of the message. It is obvious that we should now concentrate on the nature and the abilities of our information processing mechanism, that influence the forms of visual relationships we can efficiently perceive and use. This will broadly remain the focus for all the future articles.

This article begins by a brief discussion on the human information processing model, its components and its surprisingly limited capacity to handle information. We will later concentrate on chunking or unitization process that we use to overcome this capacity bottleneck. As we will see later, the relationships between the elements of the message, form the basis of unitization as well as the basis of structure.

The later part of this article specifically deals with visual relationships that prompt unit formation. We will initiate this topic by discussing the pioneering work in Gestalt psychology. Later we will briefly review work in stabilized images, which offers experimental evidence of the process of unitization in perceptual tasks. We will sum-up by suggesting an idea of visual structure of pattern represented in a more concrete form.

Human Information Processing

Even with a limited sensitivity to electromagnetic radiation, the amount of information that can be detected by our sensory systems, is enormous[6]. The sensory receptors faithfully register the events and continuously transmit the messages about the spatio-temporal changes in the input. However the later processing mechanisms do not seem to be equipped to handle so much continuous input. It is obvious that the incoming information must be very quickly processed i.e. selected or filter out. Whatever that is selected for further attention may result in a response or it may be stored in the memory for later retrieval.

It is this need to quickly deal with such a large input of information with our limited capabilities, that forces us to actively control and select what is picked up from the input. It also makes us learn strategies that will permit us to handle larger input of information.

Current human information processing theories, though represent inferential jumps, do throw light on the processing limitations, as well as the strategies used to overcome them. Active search for visual relationships and perception of visual structure in the input material, are very much the part of the strategies that we use. It is obvious that we should understand the information handling process in the brain, atleast to the extent that it permits us to consciously modulate the message or form, with predictable results.

Number of alternative models dealing with the flow and fate of information are proposed in cognitive psychology. Current views dealing with this topic, attempt to explain the process as a flow of information through series of boxes, where the message is coded, transformed, associated, stored, rehearsed, recalled or forgotten[7]

Processing limitations seem to come up at different stages, in information flow, each distinctly currupting the 'message' received. We hope to deal with each of the limitations in detail, at relevant time in this series.

Information Processing Model

We will briefly discuss the popular and accepted model proposed by Atkinson and Sheffrin, that uses the dualist concept of memory[8] Important feature of this model is that, the information from each sensory modality is separately processed by three consecutive stores, 1.) the sensory register (SR), 2.) the short term store (STS), 3.) the long term store (LTS). These stores are represented as a set of boxes. The model also emphasizes the role of control processes that direct the processing. Figure 1 shows the information flow graphically.

First store, the sensory register is rich in information, but can hold the input for an average of 250 milli seconds. Information from here flows on to the short term store, which is regarded as a working system, where the input information can be ordinarily retained up to 15 to 20 seconds. A given input can be retained longer in STS, if it is continued to be processed, else it either decays rapidly or is displaced by new incoming input.

One of the functions of STS is to 'prepare' the incoming input, so that it can get assimilated into the past experience, stored in long term store. The LTS is considered a permanent repository of knowledge, where information is located at the address, that is identified on the basis of the nature of the contents. Once in LTS, it can be held for ever and can be retrieved with a right cue.

The processing in STS obviously involves close interaction with the contents of the long term store. It may lead to either a response or a memory trace 'prepared' for its eventful storage in the well organised LTS. In the context of our discussions, such a processing can be said to include, developing a coherent internal representation from the input, so that it can be matched, categorized and reacted on, by interacting with LTS.

To initiate this processing, when an object is seen, it should give sufficient visual clues for matching it with similar past instances stored in LTS. The LTS interaction tries to ensure that its category lable or meaning is accessed. It may be easier to imagine that we attempt to position the new input in relation to the similar past inputs, in a hypothetical perceptual map - an exercise in reducing the uncertainity. The initial processing of structural information in the input, would generally lead to processing its semantic information.

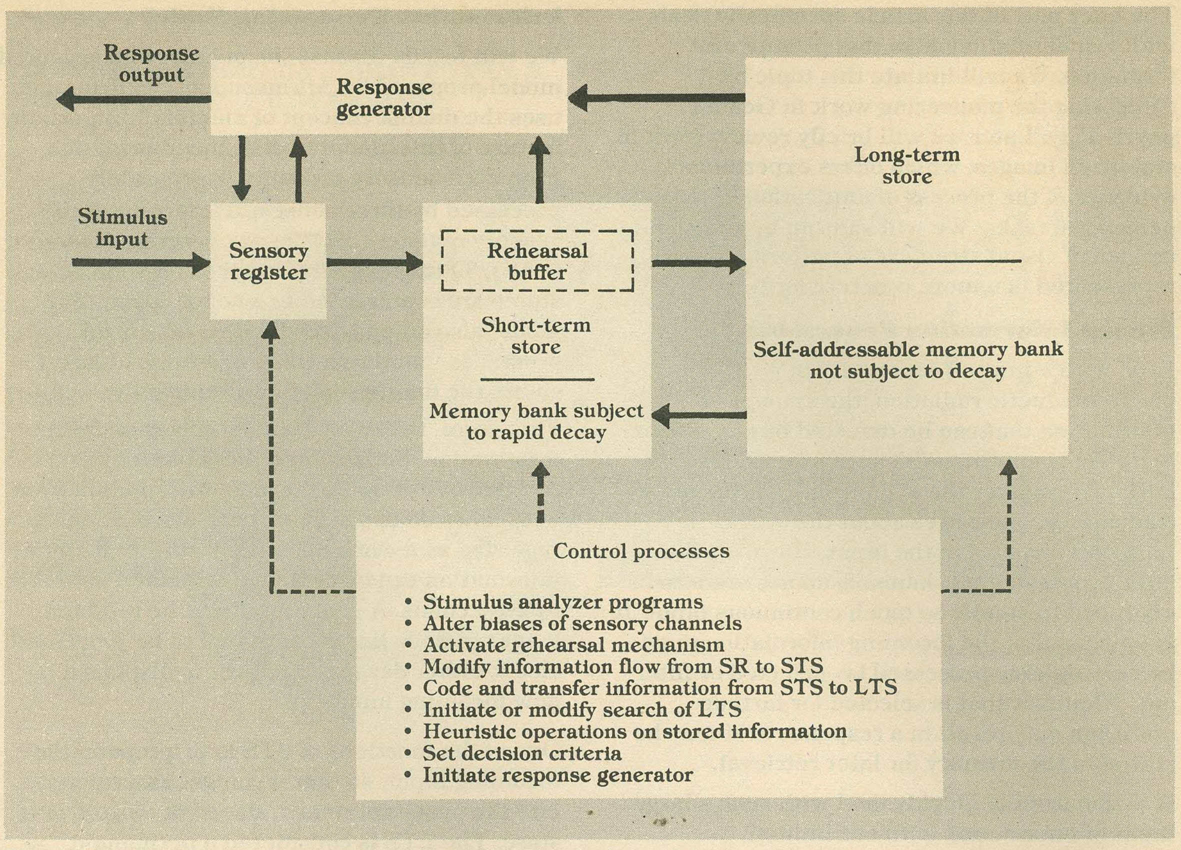


Figure 1.
Information processing model, adopted from Atkinson and Shiffrin.

The control over the information flow in and out of STS, clearly indicates that perception is not a passive receiving of information, but an active process of controlling and selecting of what is picked up. The control processes shown in the model, can monitor STS input by activating stimulus analyser programme, select sensory channel, modify information flow from the detection system, search LTS and code and transfer information from STS to LTS or activate response generator. How such an actively controlled process likely to influence the construction of the message? As a first step, we plan to discuss some of the important features of the processing system and the limitations that they impose on our information handling capabilities.

Processing System: Its Limitations

The most significant limitation on the processing capacity comes from the peculiar characteristics of the short term store. STS has limited storage capacity as well as processing capabilites. Interestingly, during STS processing, the emphasis on storage of information can be only at the expense of processing capabilities. Similarly, vigorous processing is sure to cut down on storage of information.

It is important to note that we can exercise considerable control on information flow. We may fill the STS buffer with many items, and leave little room for processing or choose to do the exact opposite. In either alternatives, we are finally restricted by the surprisingly low overall capacity.

We seem to overcome this limitation and increase our information transfer by exploiting the multi-dimensionality of the input information, as well as by chunking or recoding the input material. Both these aspects are directly connected to the concept of visual structure. We plan to discuss the later aspect, dealing with chunking and recoding of information in this article. We will return to the strategy of using multi-dimensionality of the input information, in later articles.

Another important feature is the role of control processes, that direct the information flow. The need for the subject prompted control on the information flow is again attributed to the limited capacity processing mechanism, that serves to inhibit certain information and thereby expedite the processing of the rest of the information input. We seem to direct our attention to few items and thus restrict or eliminate processing of the rest of the input. Alternately, we may deliberately shift attention to new items and eliminate old ones from the STS buffer, after a very brief processing.

Though there does not appear to be an agreement on how much initial processing of the input is carried out before some of it is selected for further processing, the concept of a hypothetical filter in the system is fairly well accepted. What is considered in the processing model given here, as one of the functions of the control processes, is treated as a filter and is often shown as another box after the sensory register, in other information processing models. It appears that input is routed through a filtering system, responsive to subject prompted control, which may exclude some or all of the input from further processing.

As designers we are interested in the general recall value of the forms that we evolve. We would also like to ensure that certain features of the forms are seen, remembered and recalled and not filtered out by the viewers. The factors that govern this selection of limited items from the input, if identified, can serve as guide lines for the development of the form.

The information processing studies indicate that continuing the conscious processing of a particular input, not only helps to retain it in STS beyond the normal 20 second period, but also increases the chances of the input being transferred and stored in LTS. The most convincing and yet familiar example is rehearsing a given list, to memorize it. This possibility leads to some questions, that are of interest to us as designers. Since rehearsal is not under our control, how else can we ensure a longer processing time? How else can we ensure better recall, in cases where it is not possible nor desirable to increase the processing time? In short, can we identify the strategies of controlling formal variables, so that we can predictably influence the processing time and/or the recall accuracy of the form/message?

The contact of the input message with the well organized long term store also suggests some specific problems. Visual input, initially represented in greater details, loses specificity with its abstract representation in memory. Full richness of original experience is rarely available. The retention of previous events in memory is not as vivid and complete[9]. Under these circumstances, as designers how can we ensure that a given message retains its identity long enough, so that it can be recalled with reasonable details? or recognized immediately when it is seen again?

Interestingly all the features discussed here, appear to be directly or indirectly related to the concept of visual structure, and we plan to discuss them in detail, at appropriate time during the series. In this article, we will begin by discussing chunking or recording of input - a strategy used to overcome the restrictions imposed by limited STS capacity.

Overcoming Capacity Limitations

Our capacity to remember limits our intelligence. So the perceptual system tries to organize material to make the most efficient use of the memory available to us. This is all the more true, when dealing with short term memory store compared to the vast amount of material stored in LTS, the STS capacity seems to be insignificant. A simple example where STS is used, will prove the point. If the subjects are presented random sequences of binary or decimal digits, letters or words, the recall seems to be always restricted to as few as seven items. Considering that we normally seem to process much more information in reality, the recall of merely seven units appears strikingly small. Even more paradoxical is the fact that, this capacity is independent of the type of data involved.

Miller first offered an explanation, that throws light on the peculiar coding process that occurs in immediate memory (STS), as a result of our efforts to overcome the limited capacity to handle the inputs[10]. We will briefly review his papers. Most of the examples and experiments he cites to prove his proposition, deal with processing of verbal material as well as language. We have included brief references to some of this material to support his argument. We will later turn to examples, directly dealing with the visual inputs.

Miller proposed that the span of immediate memory is limited by the number of units or symbols that we can master, and not by the amount of information that these symbols represent. This span is limited to seven units (plus or minus two). But we have learnt to reorganize and recode input information, mainly to make every efficient use of this limited capacity, by compressing or chunking more information per unit. We are able to deal with larger input, because we have learnt to increase the number of bits of information[11] that each unit of chunk contains. We build larger and larger chunks, each new chunk containing more information than before.

He supports this argument further by citing an experiment, where the memory for single presentation of sequences of binary digits was increased by learning a recoding scheme. It was found that learning to convert sequences of binary digits into octal digits, increased the span of memory, from nine to about 40 binary digits.

Miller also cites example of learning radio-telegraphic code. The dit and dah, treated initially as independent input elements, are soon organized into letters, words and even phrases. It is obvious that with practice, the sequences of sounds are grouped into larger chunks, which are decoded as single units.

These examples clearly show that, the amount of information retained can be increased almost linearly, as the amount of information per chunk in the input material increases. This kind of reorganization of the input into larger information rich units or chunks, is one of the powerful weapons for increasing the capacity bottleneck. This strategy enables us to package the same amount of information into fewer symbols, reducing the original complexity to something easily comprehended, without changing or disregarding any of the original details. It seems that we learn to use better mnemonic devices, to represent exactly the same information.

Miller convincingly proved that reorganization of input and the resultant unitization serves to increase information transfer and is an essential part of the communication process. However, what is important to us as designers is the clue that he offers on the relationship between the process of unitization and the nature of the input messages.

He suggested that the material is first organized into parts. Perceiving coherence in these parts is a sufficient condition to treat this set of parts as a unit or a chunk. The chunk can be also represented by another symbol or abbreviation. In fact all his examples use such a recoding strategy. For instance, recall of binary digits requires that repetitive sequences of 0's and 1's are recognized as coherent patterns and replaced by symbols like octal digits. It follows that the input that lacks coherence in its parts, would create tremendous learning difficulties, typically needing extensive rehearsals.

Miller's proposal implies learning to increase the span of memory using a recoding strategy, where pieces of information are replaced by a symbol. However all forms of messages do not lend themselves to elegant recoding schemes and most of the visual material falls into this category. In spite of this apparent difficulty, visual inputs appear to be similarly reorganized into chunks, but without a formal recoding scheme. The recall results do indicate that the chunking strategy positively contributes in information transfer. An interesting example that supports this contention, is the experiments in chess board pattern recall[12].

In these experiments, chess board patterns from middle games, end games as well as random arrangements were shown to chess master, class A player and a beginner. In memory test, they were required to reconstruct the pattern, after 5 second exposure, while in perception task they were expected to reconstruct the pattern as quickly as possible, while continuing to observe it. This kind of task heavily relies on short term store. The analysis of time intervals between placement of two pieces indicated that all the players resorted to chunking. It took longer to retrieve a new chunk from the memory, while recalling pieces from the chunk was relatively faster. The results also show that the span of memory for these chunks is almost the same as the traditional limit of STS i.e. 7 ± 2 chunks.

The analysis of recall protocol of the master showed a clear evidence of chunk by chunk recall of the pattern. Figure 2 gives an idea of the kind of chunks used by the master. His superior performance in reconstructing chess board patterns relied on his ability to put together several chess pieces into chunks and put these chunks together in a larger meaningful pattern. Though beginner also resorted to chunking, his higher errors are explained by his inability to put more pieces in the chunk. As expected the class A player committed more recall errors than the master, but less than the beginner.

Cluster of elements, similar to chunks of chess pieces, are in fact assemblages of propositions which assert that certain relations hold among elements. The results of the experiment are significant, because they establish that, the structural information conveyed by the relations between elements, may prompt the perceptual system to treat these group of elements as a unit. In absense of formal recoding or symbolic representations, the process only partially confirms to Miller's ideas of chunking, but in any case contributes in increasing the span of memory. Perhaps the idea of the chunk must be more losely defined. A chunk could be

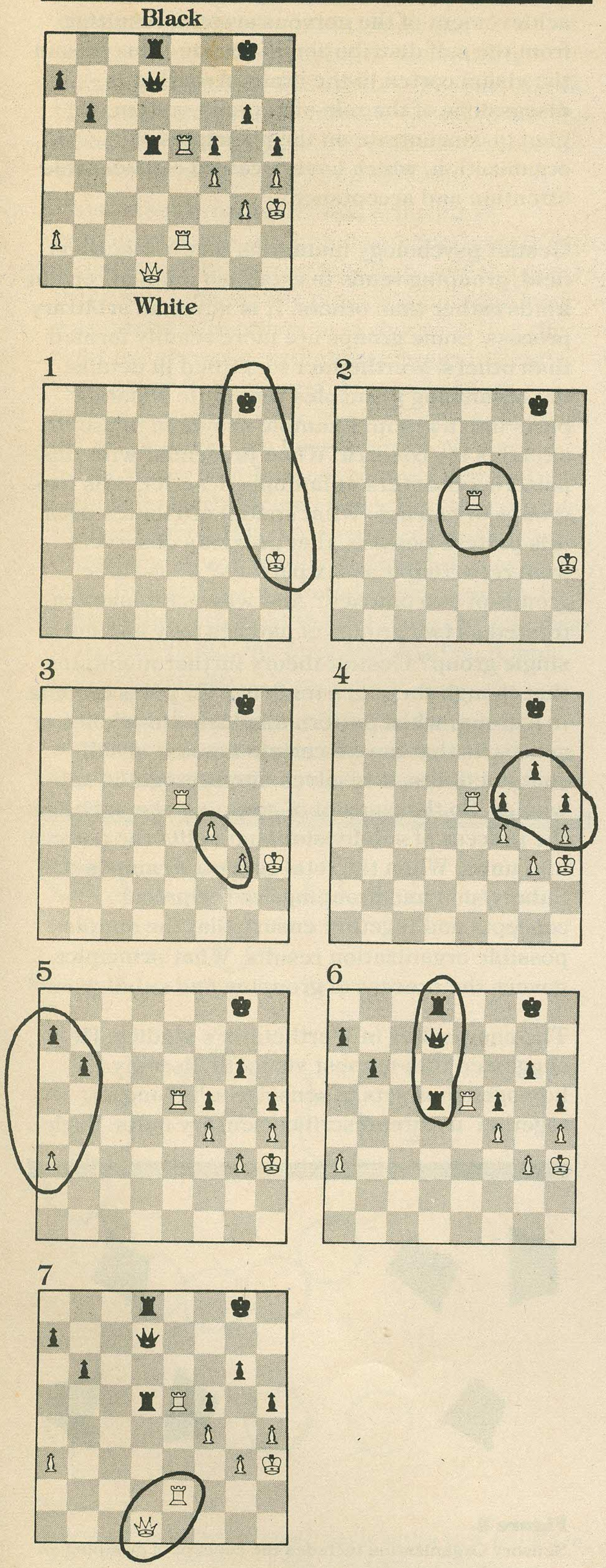


Figure 2.
The chunk-by-chunk recall of chess pattern. Each new chunk is circled.

considered a collection of pieces or items related to each other in someway[13]. Our use of the term chunk, implies this broader meaning.

Of more interest to us are the details of chess pattern recall, that elaborate on the relationship between the nature of visual input and the chunking or unit formation. Besides presenting a clear evidence that visual inputs are chunked together, the results also show that these chunks were prompted by the visual relationships within the input. In fact this part of the results, further elaborate Miller's concept of coherence in the parts, as applied to visual input.

It is surprising that the chunking or unit formation was as much based on simple visual relationships as on chess relations. Typical chunks included pawn chains and group of pieces of the same colour or functions, particularly when positioned close together. Colour, similarity, identity and spatial proximity in the pieces were not only important, but at times even dominated chess relations. The coherence of the chunk equally depended on the visual properties.

Interestingly there was no difference in the kinds of relationships noticed by different players, except that the chunks or clusters tended to be larger for the better player. The evidence suggested that, for all players the chunks are built around visual features as much as chess functions.

It appears that the span of short term memory store is limited to 7 ± 2 chunks. We overcome this limitation in perceptual tasks, by proceeding from many chunks with few bits of information per chunk, to few chunks with many bits of information compressed in them. We seem to build larger and larger chunks, each chunk containing more information than before. So, the amount of information retained and transmitted by the subject is not a constant, but increases almost linearly, as the amount of information per item (chunk) in the input is increased.

Visual messages are also subjected to the limitations imposed by our limited capacity processing mechanism and inspite of difficulties in recoding, we overcome the limitations by resorting to similar chunking of pieces of visual information together, into more information rich units. We also presented evidence that the visual relationships between the elements prompt this unit formation and increase information transfer.

How and Why are these findings important to us?

The relationships between the elements, form the basis of unit formation and by definition are also the basis of structure of form/message. Perhaps we can put the findings in a different way. It is the structure that unites the elements together and contributes in communication and information transfer. So, controlling the communication between the product form and the observer, automatically implies learning to control the structure of the form.

The kinds of relationships between the parts of the message that we can effectively perceive and use, vary considerably. Broadly speaking, similarity in the characteristics of the parts or their meaning, is likely to prompt unitization. Our limited scope only permits us to deal with the kinds of visual relationships that prompt unitization on their own, without the meaning making its contribution. For this we must go beyond the chess board patterns. A more systematic and exhaustive treatment to this topic is available in Gestalt psychology.

The Gestalt View Point

Though Gestalt theory deals with form in a comprehensive fashion, we plan to restrict the discussions in this article to the Gestalt views on formation of visual units. Wertheimer has dealt with this topic in great details[14]. He was mainly concerned with input conditions, that prompt the observers to treat spatially independent entities as a visual unit. He observed that, when a number of separate entities are presented together, it is unlikely that, in perception each entity is treated as an independent unit. In fact these entities tend to group themselves into fewer units, segregated from each other.

There are some commonalities between Wertheimer's argument and the process of chunking that we discussed earlier. Though Gestalt research preceded Miller's work by almost 30 years, both apperantly seem to directly or indirectly touch the same issue i.e. the relationship between organization of entities into units/chunks and an implied upper limit prompting this organization. However their theoretical positions are quite different.

Miller saw reorganization and recoding as a strategy to overcome STS limitation. On the other hand Gestalt theory treated sensory organization as an achievement of the nervous system, which only indirectly depended on the formal relations among the surface of the physical objects. In this theoretical framework, the organization was mainly considered as an achievement of the nervous system, resulting from the self distribution of certain processes in the visual cortex in the brain. Avoiding discussions of the role of nervous system, we plan to concentrate on the principles of organization, which have received considerable attention and acceptance.

Gestalt psychology maintains that in a sensory field, grouping tends to establish units of certain kinds rather than others. It is never an arbitrary process. Some groups are more readily formed than others. Wertheimer identified in details, the organizing principles that unite separate parts into a group. Example shown in figure 3, explains his concern. When presented with this pattern, observers unfailingly describe it as two groups of patches. What spatial attributes does this pattern possess, that prevents observers from reporting it as six patches? or as three groups of two patches? And why is the pattern treated as two groups of patches only and not a single group? Gestalt theory further maintains that though there is a tendency for parts to unite in a group, when pattern displays sub-wholes or sub-parts that have a certain amount of self-containedness, it resolves into segregated sub-wholes. So the concept of grouping also includes the process of subdivision that splits the pattern into units, When the total context demands it. Subdivision and grouping are reciprocal concepts and together ensure that the simplest possible organization results. What principles govern the process of grouping and subdivision?

The answer lies in Wertheimer's studies. He suggested that in most visual fields, only the homogeneous sets of sensations 'belong together' as circumscribed sensory units. Such

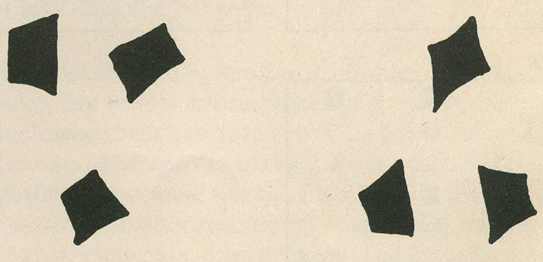


Figure 3.
Sensory Organization includes the concept of grouping as well as the subdivision, governed by the context. This pattern of six spatially independent patches is typically perceived as two groups of three dots each.

units show a spontaneous, naturally and normally expected combinations and segregations: an organisation that reflects maximum stability and creates the least stress. Meaning, names and symbolic values follow this divisions, drawn by natural organization, based on homogeneity and belongingness.

This rather broadly defined principle of grouping is even supported by experiments with birds, tamed to recover food kept under a pot. In these experiments the pot containing the food was mixed with others in such a way, that the right pot always became something strikingly segregated from the rest. Figure 4 shows various layouts of pots. In all the cases, the pots get divided into two homogeneous clusters: a larger group that does not contain food and a rather distinctly located single pot, that always contained food. The bird selected the right pot every time it was readily distinguished as a thing by itself (i.e. as an independent unit). So long as the pattern in the field was entirely clear in human vision, the bird depended on it and reacted correctly.

Grouping is also experienced in temporal sequences. A pattern can be easily constructed by controlling sound intervals in short knocks.

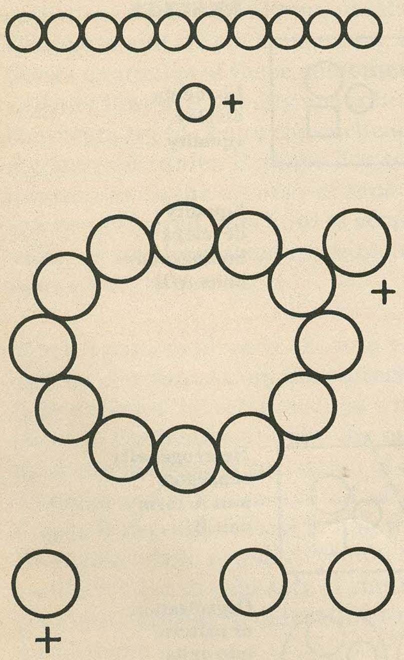


Figure 4.
Layouts of pots used in experiments with a bird, trained to recover food kept under a pot. The correct response depended on recognition of patterns created by grouping and subdivisions. The patterns that were clear to human vision were also recognized by the bird.

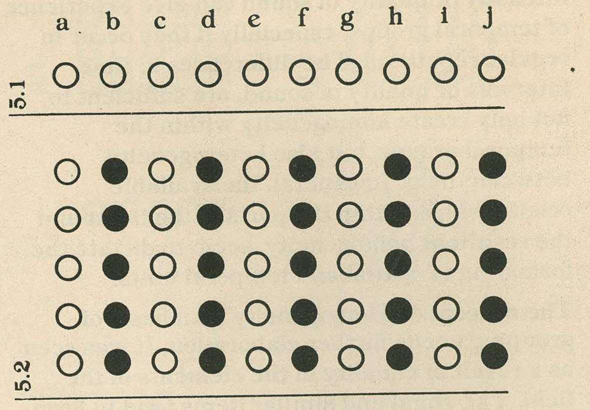


Figure 5.
Examples of groups that are determined by similarity. These equidistant elements are naturally organised into units of two similar dots ab/cd/ef. In 5.2 similarity in dots prompts formation of columns a/b/c.

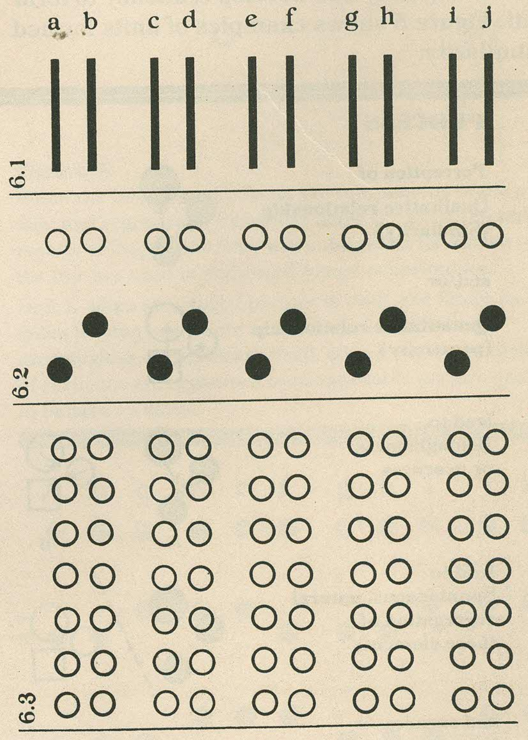


Figure 6.
The grouping and sub division is prompted by proximity in qualitatively similar elements. Elements with smaller separating distances will group together, resulting in group ab/cd/ef. So the lines are grouped into units of two lines in 6.1, twin dots in 6.2 and twin columns in 6.3.

Though each knock is an independent event, the temporal groups can be easily perceived. Even with equal intervals, differences in intensity or quality of sound can give experience of temporal groups, especially if they occur in regular repetition. The differences in time intervals or quality of sound, are sufficient to not only create homogeneity within the temporal groups, but also heterogeneity between them. In general, the available relationships within the parts of the input and the resultant homogeneity, seem to dictate the formation of spatial and temporal units.

The concept of 'Homogeneity' as a basis of grouping needs further elaboration. It was seen as a result of equality in the elements of the field. The equal and similar items tend to form units, and separate themselves from less similar items.... where this principle does not apply, relative proximity is often decisive. It is easier to explain these principles independently.

Similarity: On similarity it was stated, that the visual pattern elements that are alike tend to form units.[15] The similarity in shape, colour orientation or any other variable is sufficient to establish equality and develop tendency to form a unit. Figure 5 shows examples of units formed by similarity.

Proximity: In grouping governed by proximity, the visual pattern elements having smaller distances between them form a unit rather than elements separated by larger distances. Figure 6 shows examples of this category.

Similarity & proximity also seem to be the principles used by players in chess pattern recall discussed earlier. However, would the separate parts unite in more than one way? In short, in Figure 5, can a/bc/de be seen as units? Gestalt psychology maintains that it is possible to artificially achieve such an organization. But the tilt towards the natural organization ab/bc/de... is so strong, that the artificial organization is difficult to maintain. The perceptual efforts are always directed towards achieving the most stable organization or grouping of the elements in the field - an organization that will create minimum stress[16]. It follows that as the 'belongingness' between the elements become more intense, the group will acquire higher degree of homogeneity and stability. Figure 7 sums up the Gestalt views on grouping or unit formation, as a process consisting of set of events. It must be noted that the hypothetical break-up, does not represent actual perceptual steps.

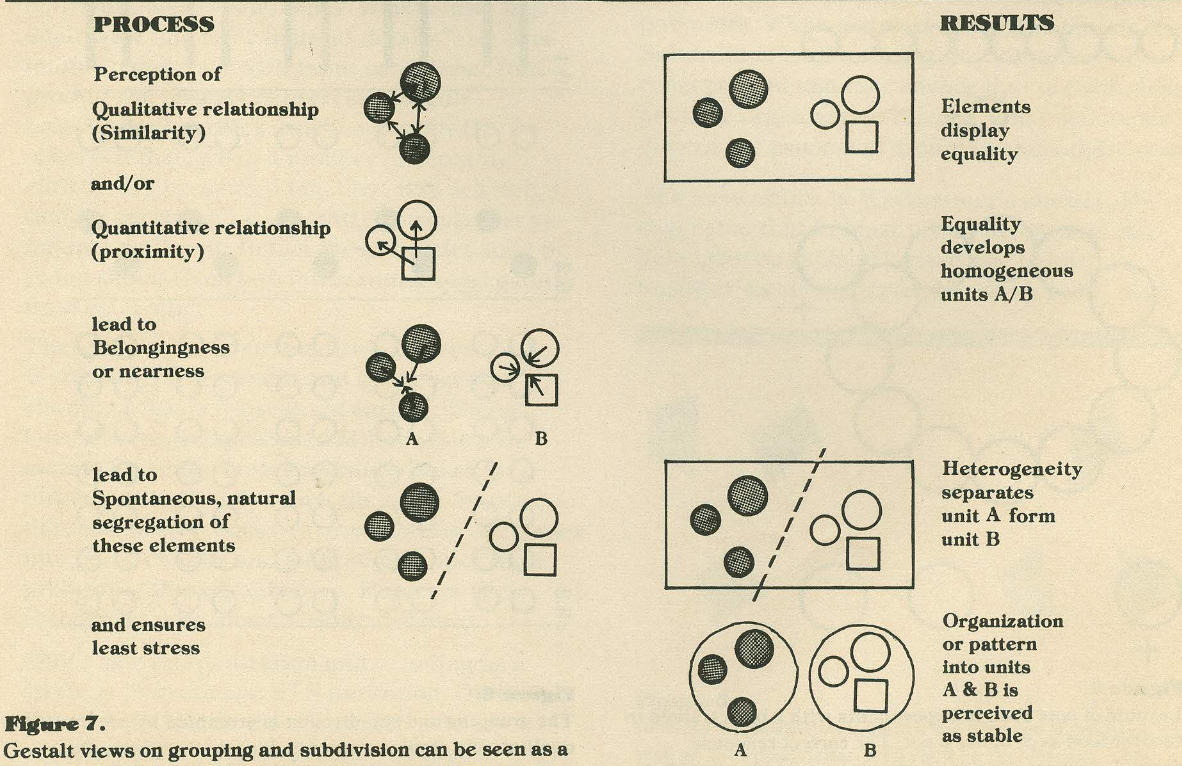


Figure 7.
Gestalt views on grouping and subdivision can be seen as a process, where forms of similarities, create belongingness between units. The elements group and divide on the basis of degree belongingness.

Experimental support

The effectiveness of Gestalt principles,.the resultant formation of visual units and the role that the visual relationships play in this process, is supported by Pritchard's experiments using stabilized image technique[17].

When the image is stabilized, the lack of mobility of the image over the ratinal cells, makes the image fade and regenerate in parts. The time as well as thė pattern of fragmentation obeys rules, which relate to the character and content of the pattern itself. When the components of the pattern fade and regenerate, the fragmentation occurs at specific places, leaving some of the components intact. The relative stability of these components suggests that, the perceptual system treats them as units, that build the pattern. Pritchard refers to them as perceptual elements. The study of the pattern of fragmentation of the stabilized images, offers itself as an interesting tool to analyze the patterns.

It is interesting to observe the results, when patterns based on the composition of elements, are used. In random pattern of curlicues, initially the individual elements fade and regenerate rapidly, and at random. However after prolonged viewing, certain combination of curlicues become dominant, persist longer and disappear and reappear as a unit. Figure 8 shows examples of these combinations. It appears that without any apparent clue, the observers try to chunk the curlicues into recognizable units. Perhaps due to the limitations on the number of separate parts that can be perceived, this kind of structuring of patterns into larger and more inclusive units, appears to be inevitable.

When a pattern already shows a very high degree of organization, the pattern of fading fully exploits the relationships within the pattern. For instance, when the pattern has a perfectly ordered organization of elements, columns and rows are treated as stable units. Figure 8 also shows how fading will typically leave one whole row and column or diagnal visible[18]. Gestalt concepts of similarity and proximity appear to determine these formations.

In either cases, the subjects group the elements into units. In random curlicues, the grouping reflected the unpredictability of the pattern, but when the elements in the pattern show specific visual relationships, these are fully used in the

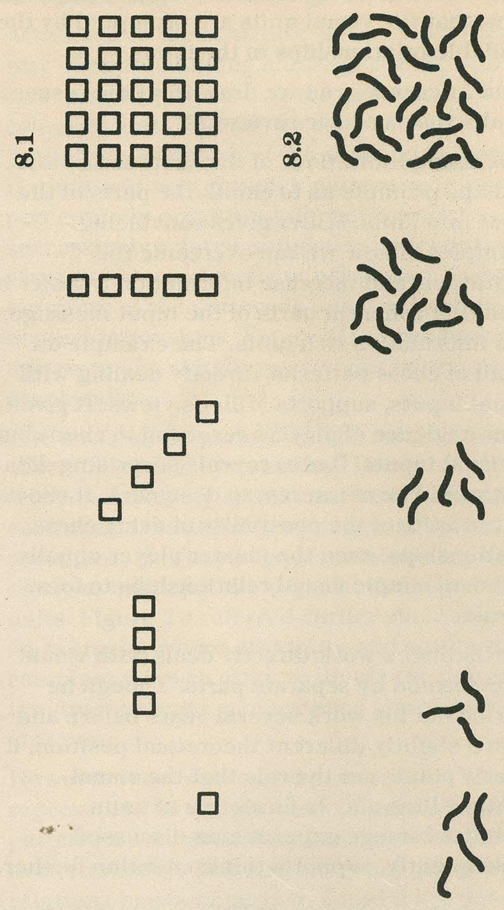


Figure 8.
When the image is stabilized, the components of the pattern fade and regenerate. Examples show the experimental results of fragmentations, when the patterns shown at the top are used in stabilized image experiments.

In 8.1. when structured pattern is used, the figure usually fades leaving one whole row visible. In 8.2 when meaningless curlicues are used, after a while, small groups of curlicues are organised in recognizable pattern and start to behave as units.

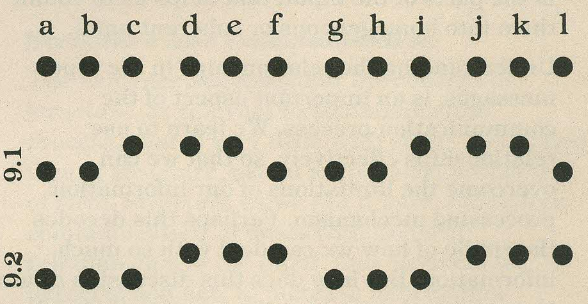


Figure 9.
When the fate of the individual parts does not go long with the fate of the unit to which it belongs as in 9.1, the results appear structurally contrary. 9.2 shows structurally reasonable changes, fate of the elements and the unit go together.

formation of the units. The findings support the view, that the visual units are prompted by the available relationships in the input.

What inferences can we draw from the research results that we have reviewed?

Processing limitations of the short term store, perhaps prompts us to chunk the parts of the input into units. Miller gives convincing examples of how we can overcome the limitations and increase information transfer by chunking coherent parts of the input message, into information rich units. The example on recall of chess patterns, directly dealing with visual inputs, supports Miller's views. It gives a clear evidence of players resorting to chunking of visual inputs. It also reveals surprising data that would be of interest to designers. It shows that in spite of the possibility of using chess relationships, even the master player equally relied on simple visual relationships to form chunks.

Wertheimer's work directly deals with visual units formed by separate parts. Though he carried out his work several years before and from a slightly different theoretical position, it clearly points out the role that the visual relationships play in formation of units. Stabilized image experiments discussed subsequently, supports this contention further.

Though the authors quoted here may not share the same theoretical position, there is a general agreement, that the perceptual system tries to reorganize independent parts of the visual message into larger units. Besides calling these clusters as units, they are varyingly referred by these authors as chunks, groups or perceptual elements.

The results also unequivocally point towards the fact that, it is the perception of relationships in the parts of the input, that helps us to chunk them into homogeneous or coherent units.

Understanding the relationships in the input messages, is an important aspect of the communication process. We learn to use relationships effectively, so that we can overcome the limitations of our information processing mechanism. Perhaps this decodes the riddle of how we can deal with so much information. But how does this discussion relate to our central theme i.e. the concept of visual structure?

Structure of Forms

In the first article, we defined structure as totality of relationships in a set of elements. Though the Gestalt literature implies ideas of structure, the use of this term became common only after the influence of information theory on pattern perception research. The new view treated existence of structure in the input, as a minimum condition for it, to qualify for a status of the form or message. Message was defined as a finite, ordered set of elements from a repertoire, and assembled in a structure[19]. The term structure was used in its broader sense to not only include relationships, but also constraints and rules used to construct the message.

Seen in retrospects, the Gestalt findings on pattern perception seem to clearly deal with the structure in visual input and can be treated as a basis of visual structure. We saw earlier that structure relies on the relationships between the parts of the message. Gestalt principles of similarity and proximity can be considered as primary visual relationships, that help to structure the pattern into units. In figure 3, the structure of the two units is exclusively depending on the relationship 'is closer to'. That this structure influences the perception, is seen in our description of the pattern, that necessarily includes references to two groups. It is the structure that unites these parts together into two groups.

When the parts form a visual unit, the individual parts partially lose their autonomy, if not identity. A fate of the single part appears to be very much related to the fate of the parent unit as a whole. The unit, as a collective entity of structurally related parts, resists changes that are inconsistant with its structure and disturb its homogeneity. Wertheimer, in his only direct reference to the term structure of the group, elaborates the concept of common fate. He suggested that the parts of the unit share a common fate. So the changes, where the fate of the individual part does not go along with the common fate of the unit, are resisted. Figure 9 gives Werthiemer's examples of such, structurally contrary as well as reasonable alterations.

Perhaps this resistance to change can be attributed to the degree of coherence or the belonging, that the units reflect. Structure and coherence are both based on the relationship in the parts, and are closely related concepts. It is important to note, that both can be controlled by changing the intensity of relationship in the parts of the message.

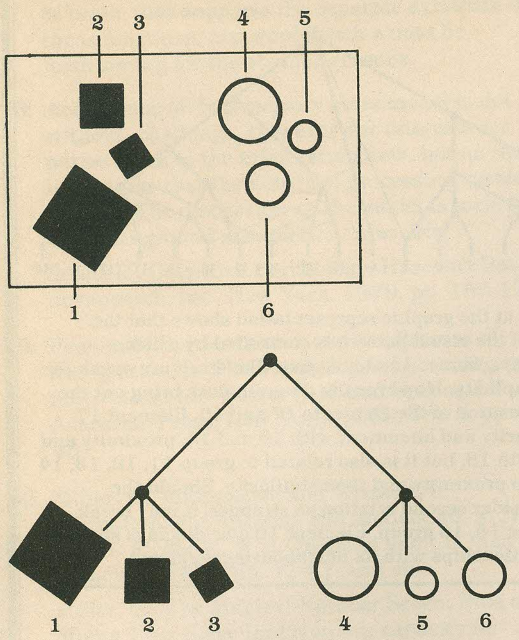


Figure 10.
Proximity and similarity complement each other, to divide the pattern into two subunits, generating a simple tree like structure.

11.1

11.2

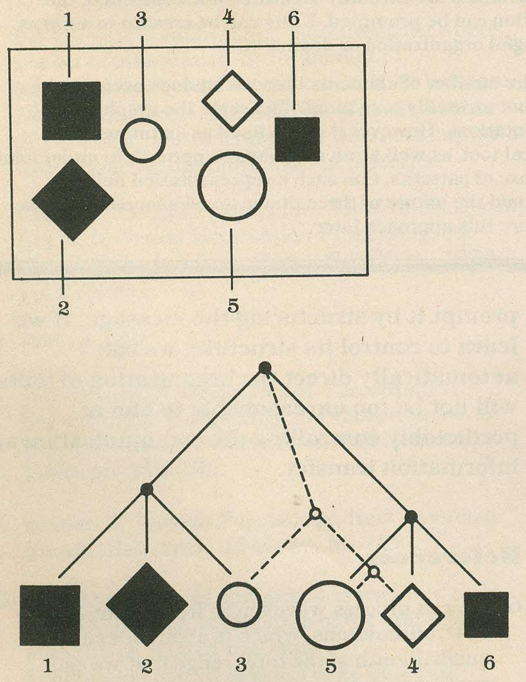


Figure 11.
When two different relationships have equal strengths, unique pattern of grouping and subdivision is difficult to achieve. In 11.1 similarity and proximity relations seem to clash. The consequent visual complexity is reflected in the semi-lattice structure in 11.2.

Graphic Representation of Structure

Attending to the structure is a more efficient way of understanding a message. Perception of structure helps to chunk the parts into fewer coherent units and allows us to cross the limitations imposed by the short term store. Understanding a complex pattern requires perceptually organizing the parts into successively related units and super-units, arranged hierarchically or otherwise. Visual structure of the pattern is infact a diagram of these relationships. Figure 10 shows how the structure of a simple pattern can be represented graphically.

The parts of the pattern can be related to each other on several dimensions. These relationships may complement or contradict each other. Gestalt theory suggests that in such situations, it is the stronger relationship that is likely to influence the organization of parts into units. Figure 10 referred earlier stands out as an example, where proximity and similarity complement each other to divide the pattern into two subunits, generating a simple tree like structure.

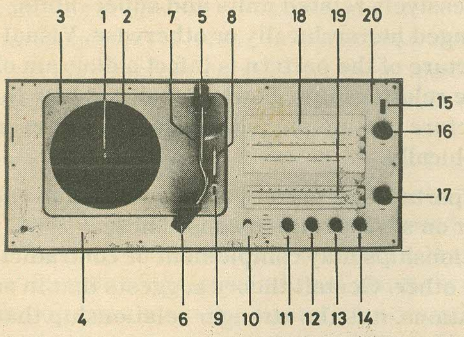
However most real world patterns can hardly be represented as simple trees. Figure 11 shows a pattern, where proximity has only a slight edge over similarity. The similarity and proximity relations between parts 3, 4 and 5 are not only noticeable, but also show a tendency to form a unit. If the two groups were slightly closer, no single spontaneous and natural division is likely to be perceived. Gestalt theory considers situations as labile, when such alternate organizations are equally possible. Its somewhat ambiguous nature is automatically reflected in a graph, that is no more a tree, but a semi-lattice structure, consistent with the characteristics of complex phenomenon[20].

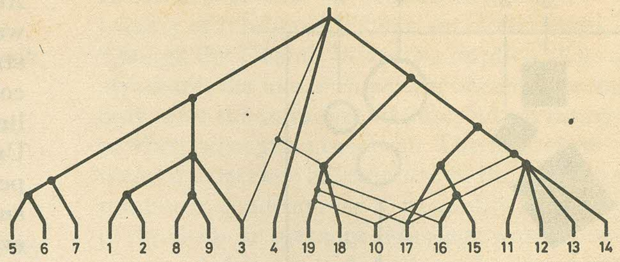
Structure and Communication

The evidence suggests that the concept of structure, as relevant to communication process, shares very little with shape dominated idea of structure, useful for physical production of form. Structure as we see it here, influences communication. It deals with kinds of relationships in the input, that we seem to perceive and use, to increase information transfer.

Our perceptual mechanism is well equipped to pick-up and effectively use, subtle qualitative relationships in the parts of the input. Wertheimer's understanding of similarity and equality relationships can be considered as a

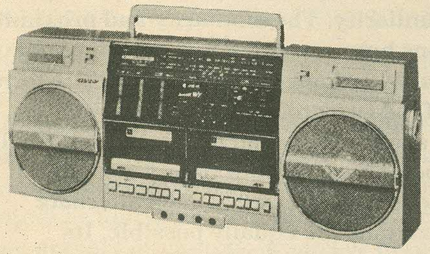
Though somewhat premature, it is possible to discuss an example of the process of unitization in perception of product form. However, with the limited background material presented so far, we must restrict to two dimensional faces of product form, in our analysis. Figure shows Braun record player. Due to limitation of space, all the elements are not included in plotting of the relationships.





A quick look at the graphic representation shows that the complexity of the visual pattern is controlled by a clear organizational scheme. An almost tree like structure speak for its visual simplicity. However the diagram does bring out the interesting position of the elements 17 and 10. Element 17 shares similarity and alienment with 16 and 15, proximity and alienment with 18, but it is also related to group 11, 12, 13, 14 mainly due to proximity and then similarity. Should the observer consider second relation as stronger, it may break away from the 15, 16 group. Element 10 also displays similar multiple relationships with its neighbouring elements.

When there is an enormous increase in the number of elements, in a limited space, proximity of elements can no more be controlled. Perhaps it is inevitable to prompt unitization by other strategies like background separation with dividing bands, grooves and joint lines. Most of the modern and functionally complex products appear to resort to this approach.



If the variables are carefully identified and controlled, the unitization can be prompted. Units can be created to support meaningful organization or destroy it.

When the number of elements increase, it does become somewhat unwieldy to manually generate the graphic representations. However it offers itself as an interesting analytical tool, as well as an alternative approach to understand the nature of patterns. Can such a representation help us understand the nature of three dimensional shapes? We hope to explore this approach later.

break-through and suggests inclusion of qualitative relationships in our understanding of the concept of visual structure. He also deals with other forms of relationships like good continuation, closure, regularity and symmetry. Together or in isolation, these relationships not only contribute towards the formation of units but also their stability. We plan to discuss these principles in detail later, in a different context.

This article deals not so much with forms of relationships, but with understanding how they influence the information transfer. It is important that we understand 'message' as an organized conscious creation. It has structure that, in perception is used to develop coherent units. Visual messages that we construct as designers, are no exceptions. If unitization is an inevitable perceptual strategy, it is important to prompt it by structuring the message. If we learn to control its structure, we can automatically direct the organization of units. It will not be too unreasonable to aim at predictably controlling the communication and information transfer.

References

6. We can process wavelength from about 350 to 750 millimicrons, which is about one ten quadrillionth of the total range that we can explore with the aid of physical devices. Our range, restricted to visible region of the spectrum, roughly corresponds to the range of electromagnetic energy available on earth.

7. The processing models show only a hypothetical structure, proposed on the basis of results of carefully designed experiments. At the moment

there is no physiological evidence on the structure of brain, that supports the separate existence of these functions, nor would such a data be forthcoming for the obvious reasons.

8. Acceptance of dual memory store model is not without challenge. However our interests are not so much in the information flow, but on the limitations that the nature of processing system impose. The discussion on the model is included as a background information. Also refer

   Solso, R., Cognitive Psychology, Harcourt Brace, Jovanovich, Inc., New York, 1979, pp. 156-172

9. Posner, M.I., Abstraction and the Process of Recognition, In The Psychology of Learning and Motivation, eds. Bower G.H. and Spence J.T., Academic Press, New York, 1969, Vol. 3, pp 44-48.

10. Miller, G., Information and Memory, In Perception: Mechanisms and Models, ed. R. Held and W. Richards, W.H. Freeman and Co., San Francisco, 1972, pp. 17-21. and also,

    Miller, G., The Magical Number Seven, Plus or Minus Two: Some limits on our capacity for processing Information, In Readings in Perceptions, ed. Wertheimer M., Van Nostrand, New York, 1966, pp. 90-114.

    Miller has used the term 'immediate memory' in his papers. However its characteristics closely correspond with the concept of short term store proposed later, in dual memory models.

11. Bit is a unit of information measurement, where one bit of information is the amount of information required to make a decision between two equally likely alternatives. We will discuss this concept in greater details, when dealing with measurements of information in patterns.

12. Chase, W.G. and Simon, H.A., The Mind's Eye in Chess. In Visual Information Processing, ed. Chase W.G., Academic Press, New York, 1973, pp. 215-281

13. Ibid., p. 240

14. Wertheimer, M.,Principles of Perceptual Organization. In Readings in Perception, ed. D. Beardslee and M. Wertheimer, Van Nostrand, 1966, pp. 115-135.

15. Kohler, W. Gestalt Psychology, New Amercian library, New York, 1947, pp. 80-122

16. For the purpose of analysis, it is useful to treat Gestalt ideas on segregation of the unit and its stability as related concepts.
    Segregation of unit appears to be based on minimal 'belongingness', sufficient for emergence of the unit in the field. On the other hand, stability is linked to the intensity and strength of 'belongingness', within the elements forming the units. So a stable configuration would imply homogeneous units consisting of elements with higher order of equality. At the moment, we are more concerned with primary process of segregation of elements into an unit, and its stability.

17. In this technique a tiny projector is mounted on the pupil. This synchronizes the eye movements with the movement of the mounted image, eliminating the mobility of the image over the retinal receptors. refer,

    Pritchard, R.M. Stabilized Images on the Retina, In Perception: Mechanisms and Models, ed. R. Held and W. Richards, W.H. Freeman and Company, San Francisco, 1972, pp. 176-182.

    Pritchard, R.M., Heron, W. and Hebb, D.O., Visual Perception Approached by the Method of Stabilized Images. In Readings in Perception: Principles and Practice, ed. Fried Peter, D.C. Heath and Company, Lexington, Mass., 1974, pp. 246-256.

18. In a similar experiment reported by Evans, this pattern of fading is only partially replicated. He observes that there is a tendency of whole line of dots to disappear as a unit, but patches of dots with no definite geometrical shapes also disappear together. Refer,

    Evans C.R. and Piggins D.J., A Comparison of the Behaviour of Geometrical Shapes, When Viewed Under Conditions of Steady Fixation. In Experiments in Visual Perception. ed. Vernon M.D., 2nd ed., Penguin Books, England, 1970, pp. 327-339.

19. Mole, A., Information Theory and Esthetic Perception, University of Illinois, Chicago, 1968, p. 9.

20. Alexander, C., A City is Not a Tree, Design, 206, 1966, pp. 46 - 55

    Alexander has discussed the potential complexities as well as the subtleties of semi-lattice structure. Interestingly he has included an analysis of Nicholson's painting, which uses similar overlapping relationships as a basis for generation of structure. Though the example is used for a different purpose, it does show how complexities of relationships in a visual input can be represented in form of a semi-lattice structure.

■

PRODUCTS FROM RURAL INDIA

Haku Shah

An earthen pot is taken as a mould, it is inverted and a layer of wet clay is plastered on it. There could be three possible reasons for this plastering: 1) Using the earthen pot as a fundamental support, instead of preparing it on a wheel or by pressing. 2) What could be better than using the pot itself as a mould? 3) Ensuring that another pot of the same size could be easily put inside.

An understanding the process, a scientific appreciation of the steps involved and farsightedness regarding the object to be placed inside - is the basis of the story. These were the early beginnings of the Kothi - a container - as a concept. The plastered layer resembles a bowl and after it is partially dry a sort of a leg is added to it which is narrow at the top and slightly broad at the joint. After initial drying, this leg is put aside and the other three legs are prepared similarly - thus forming the four legs for the base of the Kothi. These four are then inverted and kept so as to form a squarish shape by their assembly with their edges touching each other. Thereafter begins the process of joining them together.

Once these have been correctly arranged, the outer wall is gradually covered with clay which has been rolled into a rope-like shape. Going round and round this rope-like clay builds itself into the sides by being pressed together with hands. This process produces a roundish form which becomes broader and broader as it goes up - so that it may hold a large amount of air. Ordinarily, one would think the height of the Kothi should be just sufficient to accomodate a Matla (an earthen pot). However, the final height of Kothi is nearly two and a half times this height - and it may seem from the top that a lot of space is wasted. But on second thought it is clear that this space is intended to keep the air inside the Kothi sufficiently cool. Earth, cowdung and grass - these elements are mixed up to prepare the raw material for the Kothi. Water is added to form a soft dough which is plastered by hand so as to narrow down the mouth of the Kothi from its broad middle so as to hold the air inside. At the point where the narrowing begins, a strip is added around the Kothi as an adornment. Further, during the construction the mouth of the Kothi becomes small and round - small enough to admit the earthen pot inside it and round to suit its shape. So sensible!

- The clay-pot which is to be kept inside was similar to the pot which was used as mould to make the lower portion - so that it snugly fits inside.
- The base inside the Kothi is so designed as to fit the pot to be placed inside in such a way that it would be easy to lift out also.
- Some space that is left vacant may be utilized for storing small coins or small trinkets & such things.
- Some may feel the emply space remaining after the pot is kept to be a waste but this empty space is absolutely necessary.

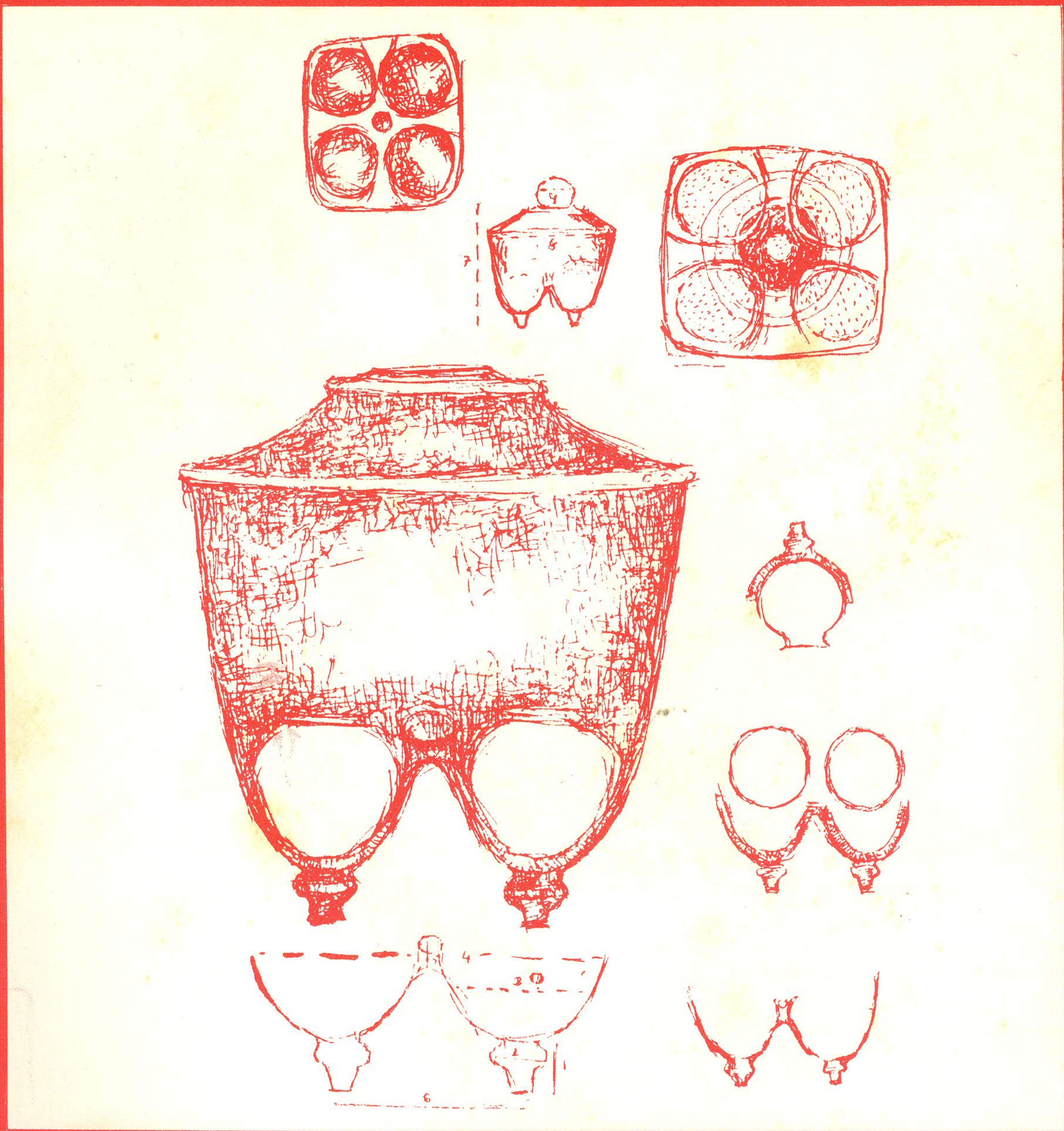
  It is bad enough that we don't appreciate need for open spaces. This open space within the Kothi is the result of an understanding by the Adivasis of the need for open space - so that the food stuffs stored in the earthen pot - rotlas, milk, curd - remain cool and the Kothi serves as a refrigerator.
- By providing open space within a small enclosure - both concepts of 'space' and 'form' have been well realised.
- The understanding that round fits easily into round, made the mouth of the Kothi round.

Overall the form of the Kothi is simple, decorated only with a few strips all around. Its legs are small but strong so as to bear the weight of the whole Kothi. Depending on the composition of the mixture of earth, cowdung and grass, the earth by itself has a characteristic to maintain the shape of an article formed by it upto a point. Should this shape become too broad - the mixture may not hold and the structure would collapse. This is based on a perfect understanding of the characteristics of the mixture of earth, cowdung and grass as well as correct craftsmanship applied to it.

The shape of the Kothi inspires me to believe - like a dreamy reality - that

The two supports are legs
The lower part forms the bosom
The middle is the body
And the mouth is at the top

As if the Adivasi woman has made her own portrait.



Kothi

Area : Poshina

Medium : Earth, cowdung and grass, shaped by hand.

Used by Bilgarasias for storing and preserving their daily food like rotlas, curd, milk etc.

(From the collection of the Tribal Museum, Gujarat Vidyapeeth, Ahmedabad)

Details:

Heights of the legs: 8 cms
Breadth of the legs: 12 cms
Circumference of the mould: 28 cms
Breadth of the two parts: 57 cms
Middle dent: 36 cms
Distance between two legs: 33 cms
Breadth of the Kothi: 98 cms
Height of the Kothi: 97 cms
Circumference of the mouth: 45 cms


भेड़िया! आ ग
मारो
भेड़िया