INDOOR PERMANENT EXHIBITS

EXHIBIT CATALOGUE

LIGHT AND SIGHT

NEHRU SCIENCE CENTRE

NATIONAL COUNCIL OF SCIENCE MUSEUMS

Permanent Indoor Exhibits

LIGHT & SIGHT

designed and developed in 1979
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NEHRU SCIENCE CENTRE
Bombay

NATIONAL COUNCIL OF SCIENCE MUSEUMS
SECTOR V, BLOCK-GN, SALT LAKE CITY, CALCUTTA 700 091 • INDIA

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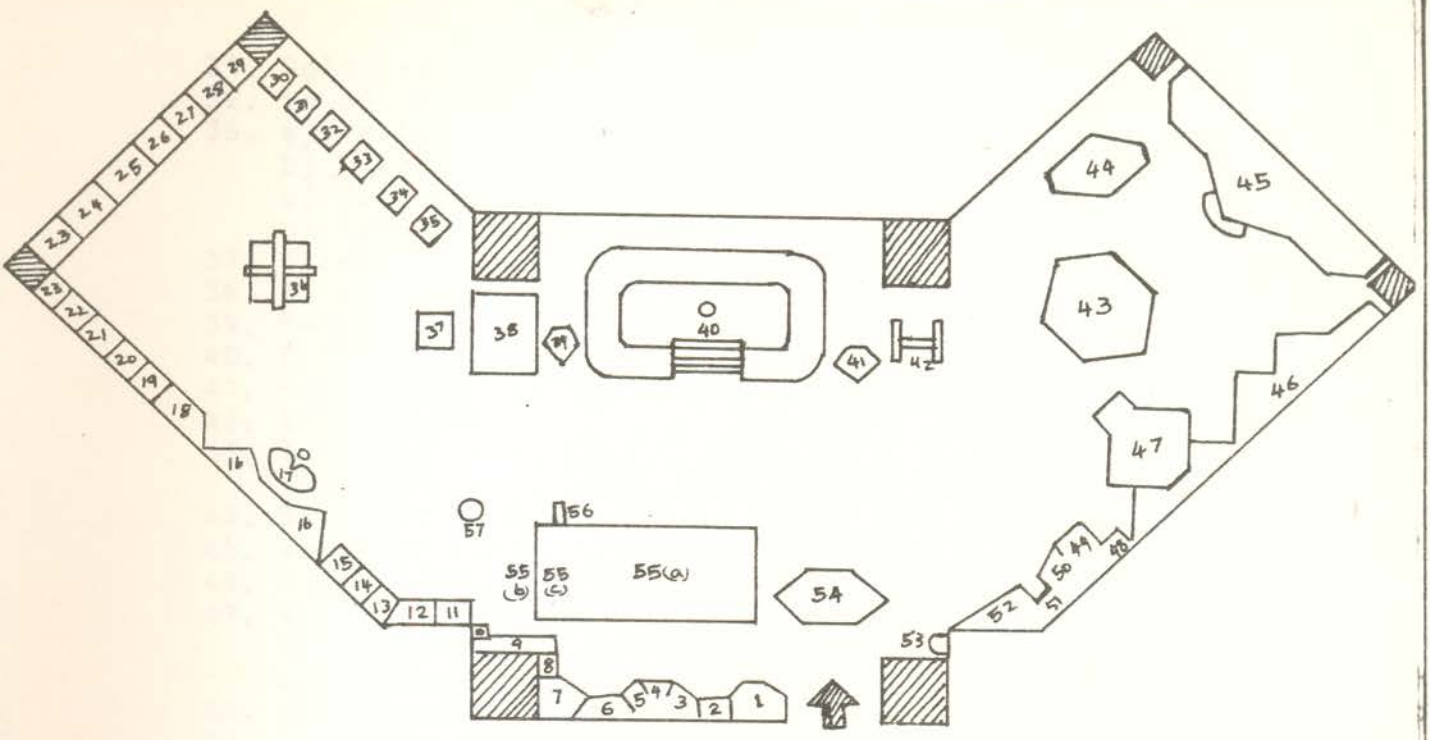

1. a) The eye, a gateway to perception
   b) A fly has 1000 eyes
2. Whose eyes are these ?
3. Can you see at night ?
4. Defects of vision
5. Why do we have two eyes ?
6. Sight needs light
7. When your brain commits mistakes
8. Illusion drawings
9. Colour contrast
10. Lens magnifier
11. & 12. Colour Boundary
13. Reverse masks
14. Illusive cubes
15. Combined vision
16. Telescope (reverse)
17. Peripheral vision
18. Colour
19. Newton's disc
20. Colour subtraction
21. Complementary colours
22. Phosphorescence
23. Bombay 1880-1980
24. Colour reversal
25. Colour contrast
26. Colour resolution
27. Diffraction
28. Colour from gases
29. Colour from air
30. Catch the coin

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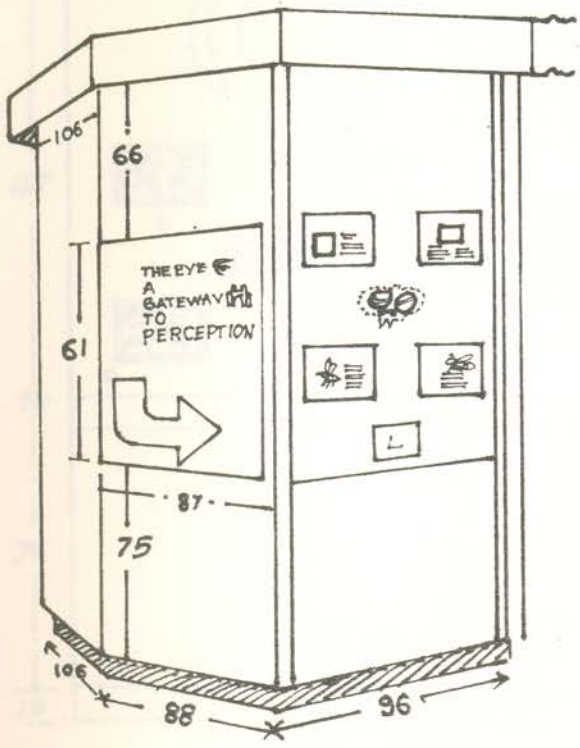
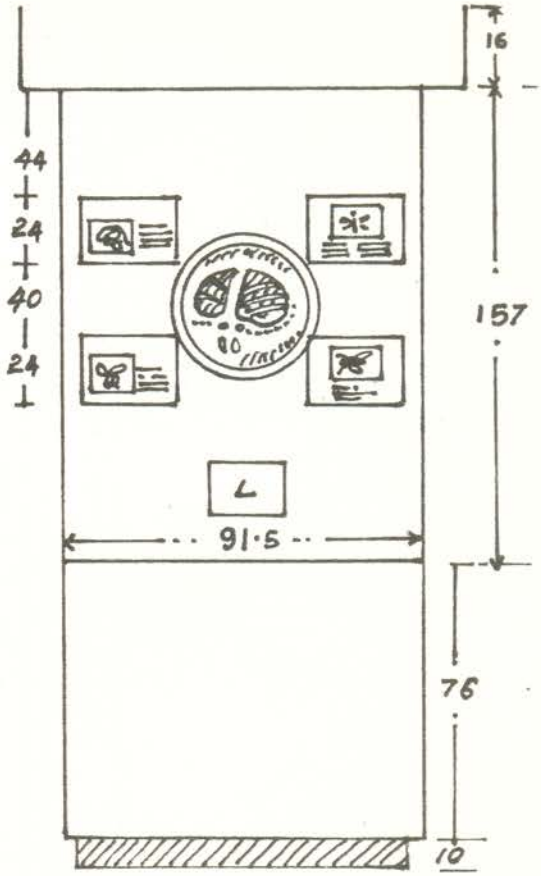
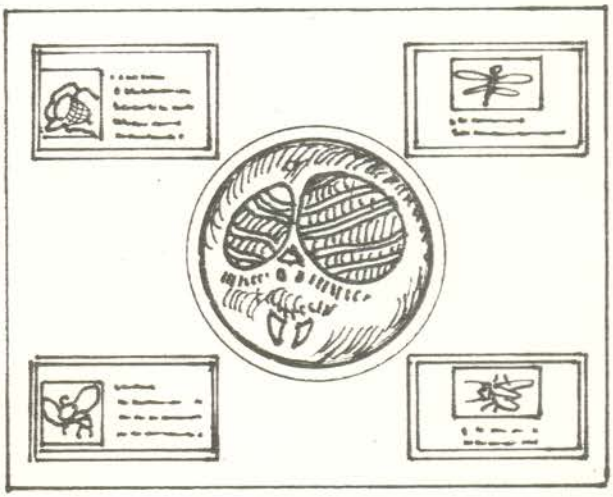
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
ALL DIMENSIONS IN C.M.		

31. Polarised machine
32. to 35. Stress pattern
36. a) Periscope
    b) Microscope
    c) Perismate binoculars
    d) Prism binoculars
37. Mirror graphics
38. Is it you or me ?
39. Reflection
40. Optical fibres
41. Refraction
42. Stereo vision
43. TV, satellite, LASER, X-ray, radioactivity, gamma rays
44. Symmetry exhibit
45. World of lamps
46. Photography
47. a) LASER pattern
    b) Banya Bapu
    c) Expanding spiral
48. Stroboscopic effect
49. Size and distance
50. Dancing gears
51. Persistence vision
52. Dancing square
53. Hologram
54. World of eyes
55. a) Check your eyesight
    b) Eye and camera
    c) Colour blindness
56. See your pupil
57. Hand eye co-ordination
58. Praxinoscope

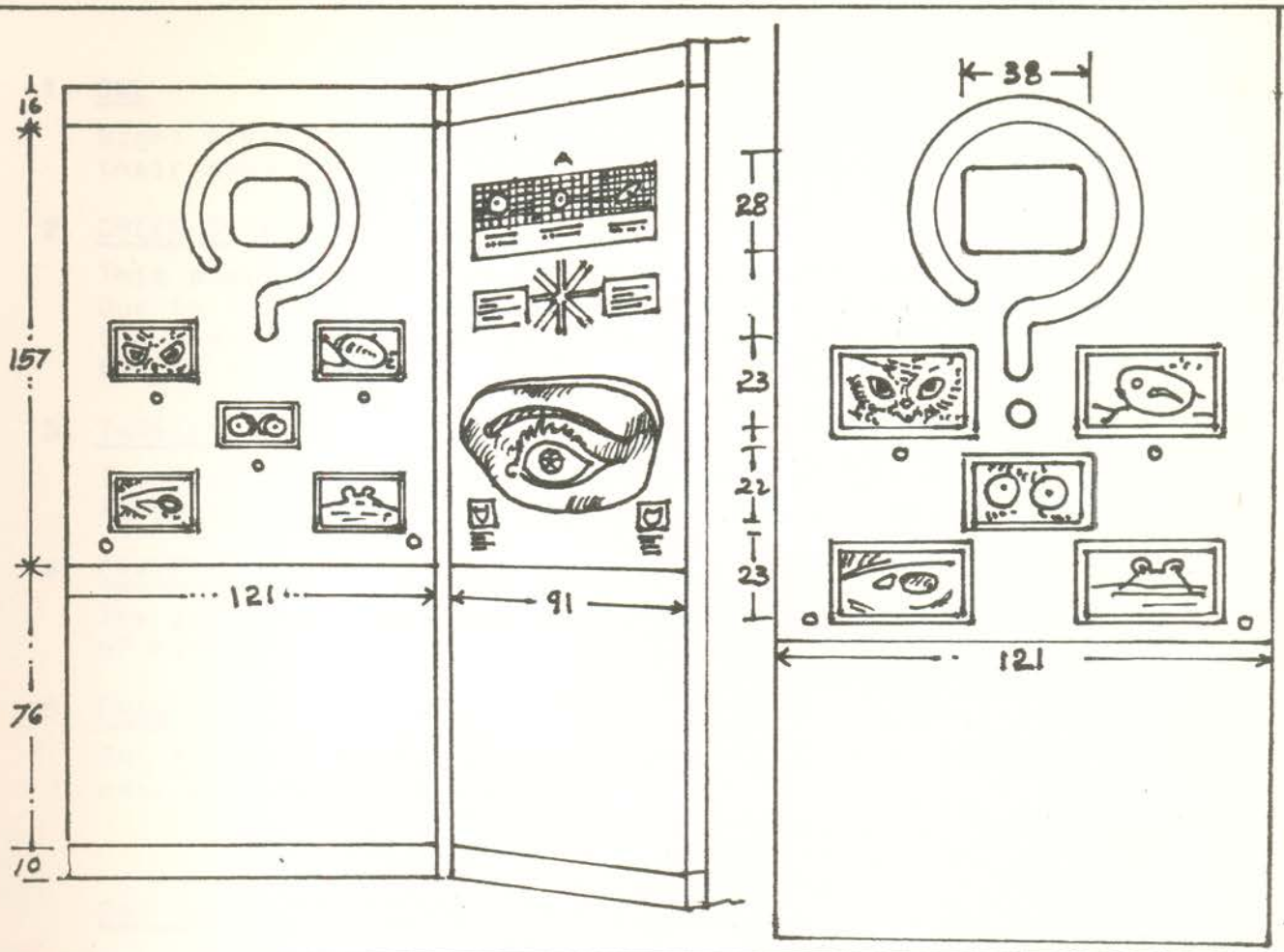




The insect's compound eye is made up of many separate parts called ommatidia. Each ommatidium has a lens which cannot change its shape and an insect's eye cannot focus, but it is very good at detecting slight movements. This is why it is so hard to swat flies.

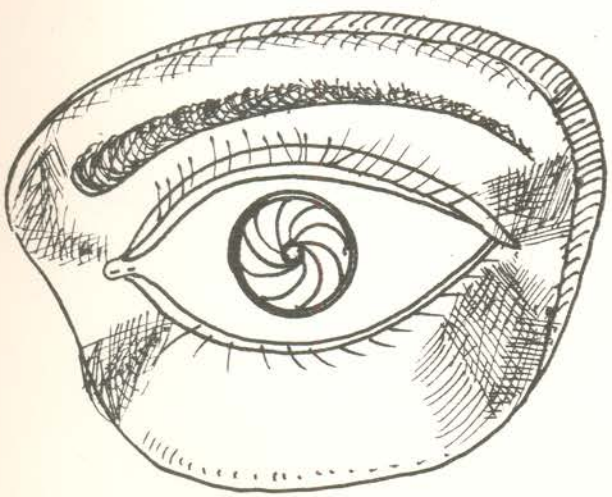


NEHRU SCIENCE CENTRE BOMBAY. N.C.S.M.		
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
1	WORLD OF EYES	INSECT EYES
ALL DIMENSIONS IN C.M.		



1. OWL
2. GREEN SNAKE
3. TARSIER
4. CRAYFISH
5. FROG

1. Non-astigmatic view of a multicolour ball on a symmetrical grid
2. Vertically astigmatic view
3. Obliquely astigmatic view



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LIGHT & SIGHT		
SL.NO	SECTION	TITLE
2	WORLD OF EYES	EYE QUIZ
ALL DIMENSIONS IN C.M.		

1. OWL

Night prowling animals usually have larger pupils so that their eyes are able to catch every stray glimmer of light.

2. GREEN SNAKE

This snake has its iris in the shape of the hole of a lock. Due to the horizontal slit in the iris, it can see clearly the scene in front of it. It can see all around because the iris is round in shape.

3. TARSIER

The tarsier, a night prowling cousin of the monkey, has the largest eye in proportion to its head of any known mammal.

4. CRAYFISH

The large compound eye of a crayfish glints with hundreds of minute lenses.

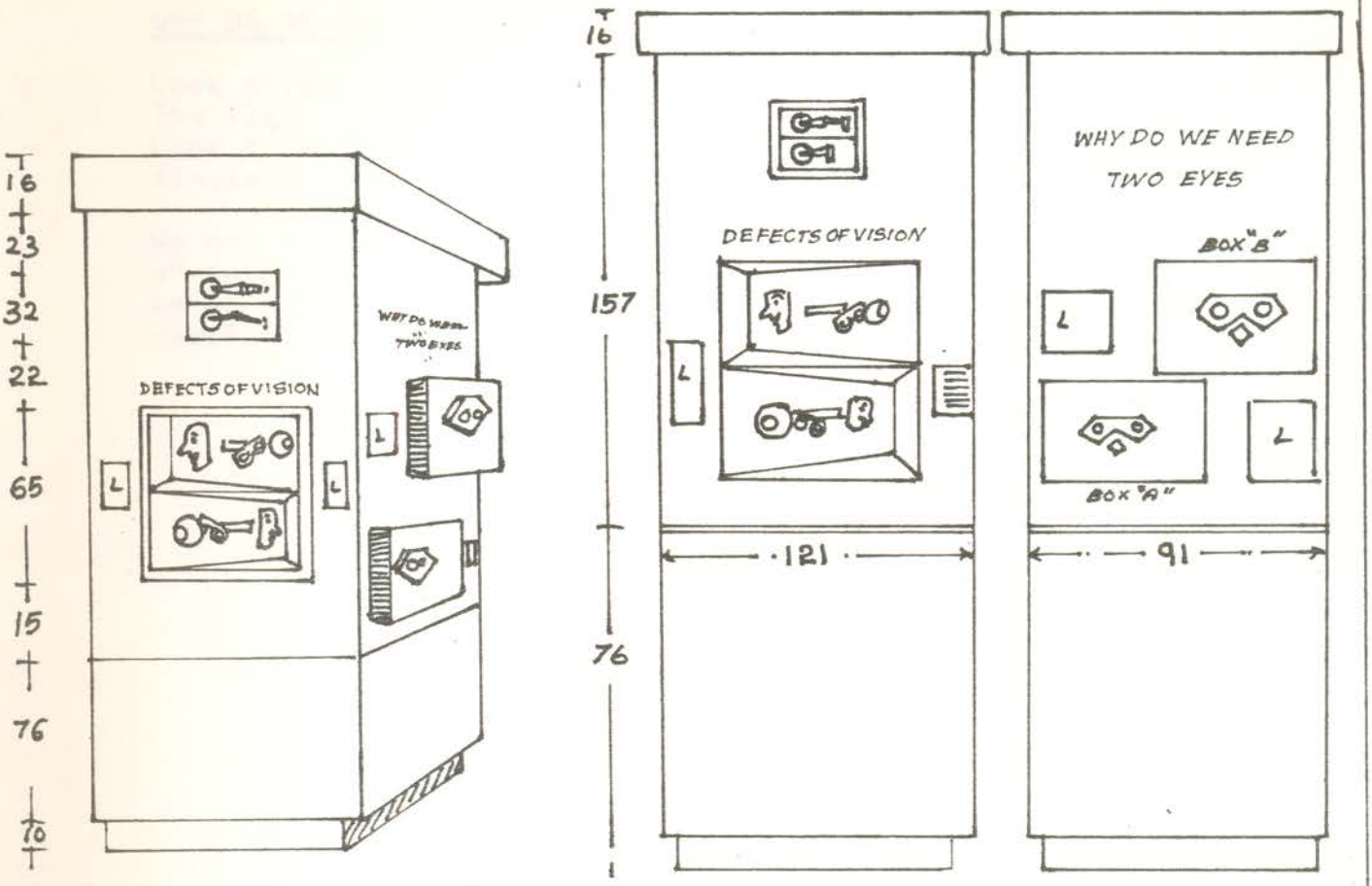
5. FROG

The frog's eyes are placed high on its head, enabling it to peer over top of the water.

CAN YOU SEE AT NIGHT

A) Can you see all radial lines sharply ?
If all are equally sharp your cornea is alright. If some are blurred, you are suffering from astigmatism which is usually caused by a defective cornea. Cylindrical lenses can correct this defect of vision.

B) We have in our eye, a device called iris which closes down in bright sunlight, cutting the amount of light entering our eye. In dim light, the iris opens up allowing maximum light to pass. Check the function of iris in this model.



DEFECTS OF VISION

In a far sighted eye (Hypermetropic), the image of nearby object is formed behind the retina. A convex glass, by converging the light rays, helps to focus light rays on the retina.

In a near sighted eye (Myopic), light rays from a distant object converge not on the retina, but in front of it. A concave glass, however, diverges light rays slightly, and the image is made to focus on to the retina. Turn the knobs and see how the lenses correct the vision.

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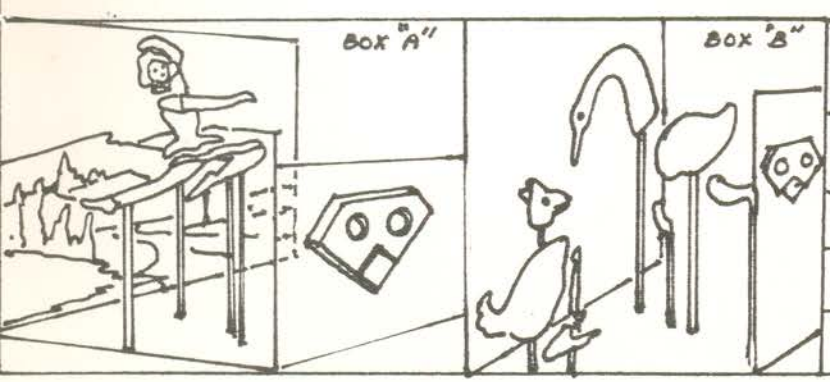

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LIGHT & SIGHT

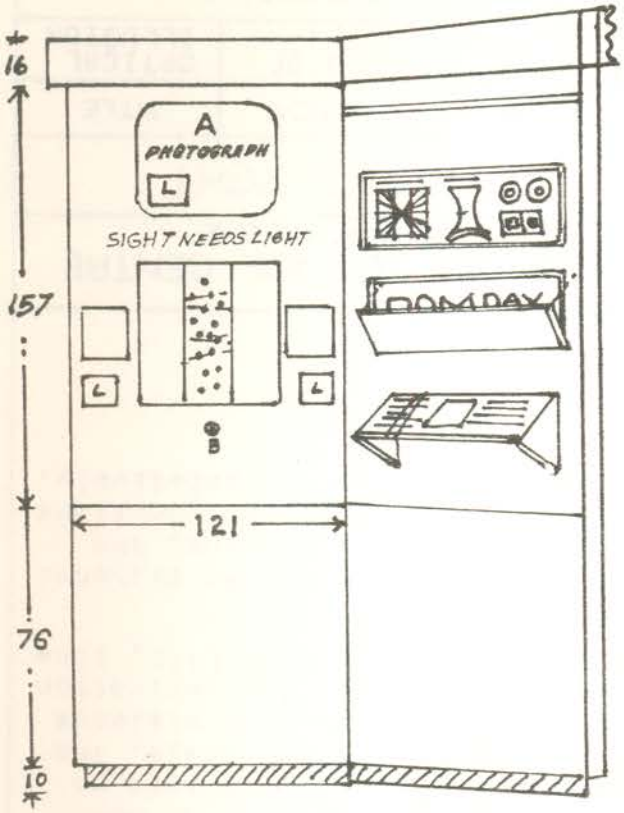
SL.NO	SECTION	TITLE
3	WORLD OF EYES	DEFECTS OF VISION

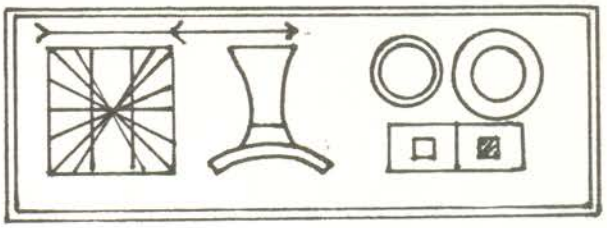
ALL DIMENSIONS IN C.M.

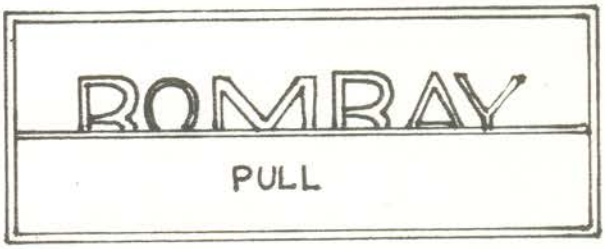
WHY DO WE NEED TWO EYES

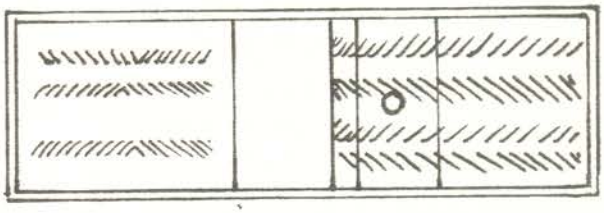
Look through the hole with one eye and two eyes alternately. The figure inside appears to be one if looked at by one eye. Look through the side glass, it does not appear to be a single figure.

We can see an object from two different angles with the help of two eyes. These two visions combine in brain and we perceive depth which is not possible in case of single eye viewing.



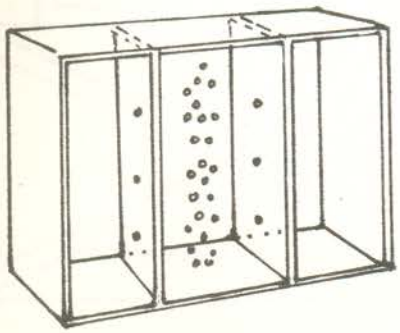






A) This photograph shows the colour of the sky as it appears at altitudes attained by manned spacecraft. Because there is no atmosphere in space to reflect or scatter sunlight, the sky appears black.

B) Press the button and observe that light rays are visible only in the middle chamber and not in the other two. In the middle chamber, particles are blown which scatter the passing light and the side chambers containing nothing but air, remain dark. A light ray is not visible unless it is reflected or scattered by objects in its path.



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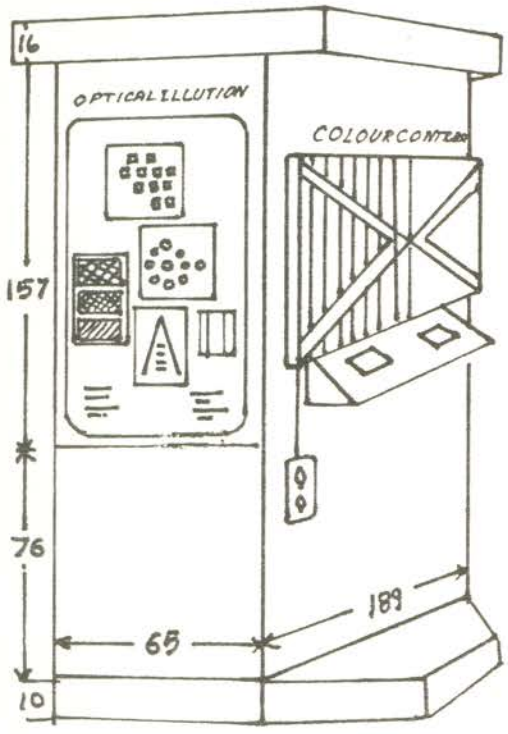
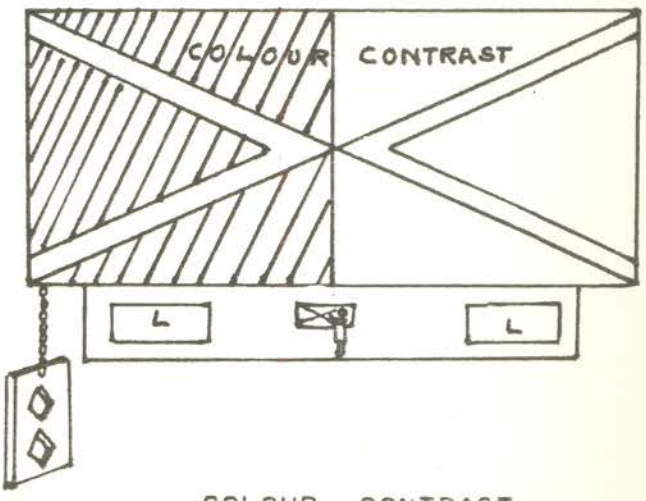
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
4	WORLD OF EYES	SIGHT NEEDS LIGHT
ALL DIMENSIONS IN C.M.		

OPTICAL ILLUSION





COLOUR CONTRAST

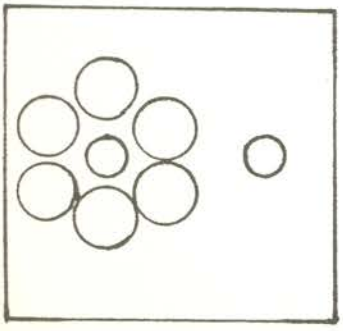
Look at the X mark on the board. Two halves do not look identical in colour. Keep the rectangular mask at the centre of the board and observe the colour in the holes. It looks to be same.

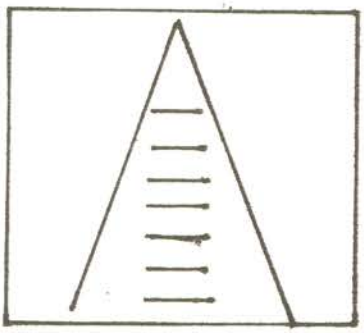
Here the colour of two halves looks different due to colour contrast as one half is in black background and other in white.

Look at the letters LIFE. The letters on the top and bottom do not look straight whereas in the middle they do. In fact the letters on the top and bottom are also straight. Check it by using a scale. The twisted cord or the black and white alternative combination misleads the directional analysers of our eyes. If a line drawn by combination of black and white lines, as it is done in case of letters LIFE, line looks curved.

Look at the pattern of black squares and white junctions. At diagonal junctions shadows appear. Due to the contrast of black colour, the white space between two black areas is enhanced whereas, at junctions the effect of black is lesser and white area is dimmer comparatively.

GRAPHICS OF OPTICAL ILLUSION





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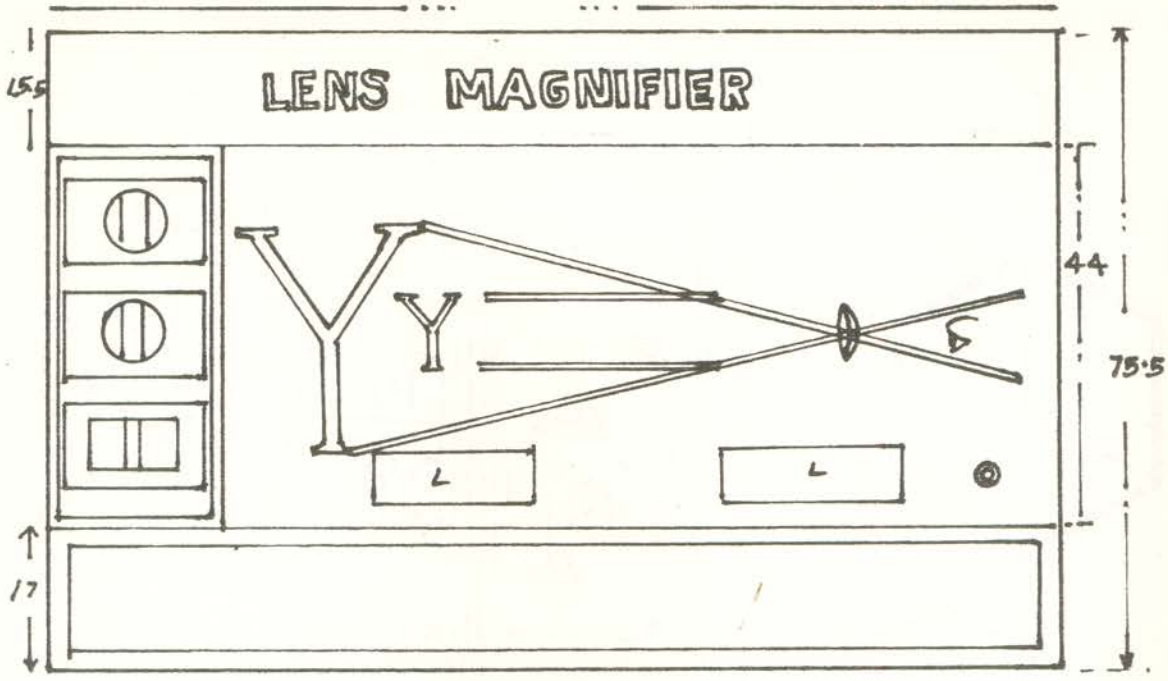
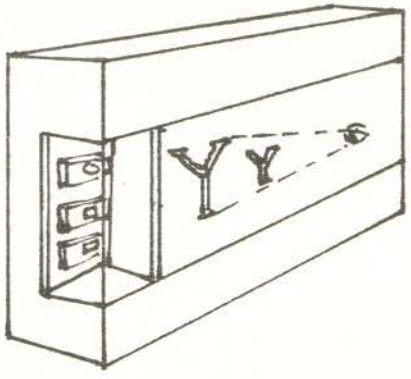
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
5	WORLD OF EYES	OPTICAL ILLUSION
ALL DIMENSIONS IN C.M.		



LENS MAGNIFIER

If you place an object within the focal length of a converging lens, the rays from the object no longer converge to form a real image which can be cast on a screen. Instead, the rays appear to diverge from a distance behind the object and the object appears magnified to you.



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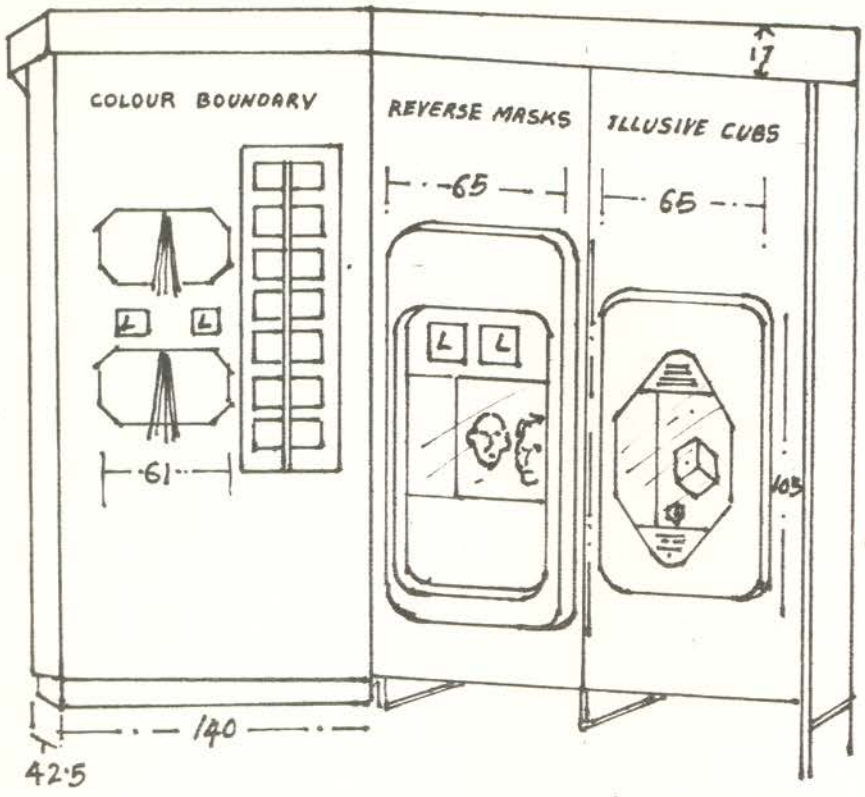
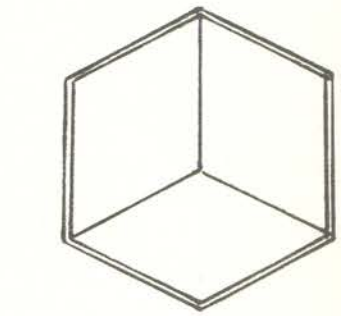
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
6	WORLD OF EYES	LENS MAGNIFIER
ALL DIMENSIONS IN C.M.		





COLOUR BOUNDARY

Look at the large blue square on the board which is divided into two halves by the hanging rope. Lift the rope and observe. Do you find two distinct colours?

Edge separates one thing from another. Our eyes concentrate on the edges and boundaries stressing the differences and ignoring the fine gradation in lighting across each half. Lateral inhibition magnifies the effect in the visual field, when our eye-brain is not able to select the very fine changes in brightness. In fact, very fine changes are hardly noticed if there is an abrupt change.

REVERSE MASKS

Look at the two faces from the observation point. Both the masks look convex. In fact, they are not the same. Watch the faces from a closer point.

The concave mask moves along with you if you move sideways. Observe the concave mask from different points and notice its movement.

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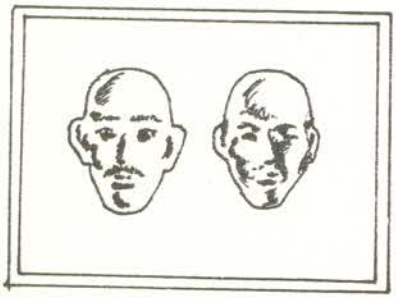

REVERSE MASKS.

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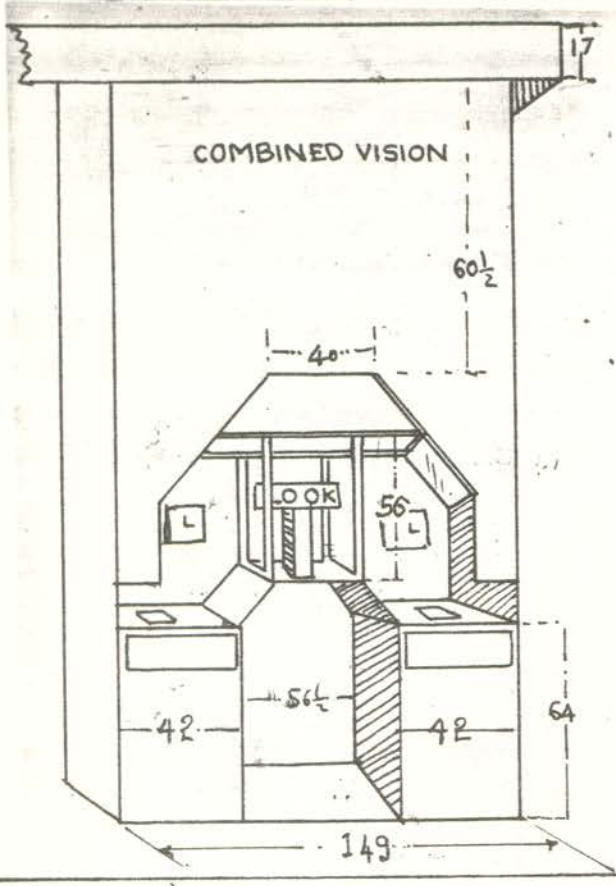
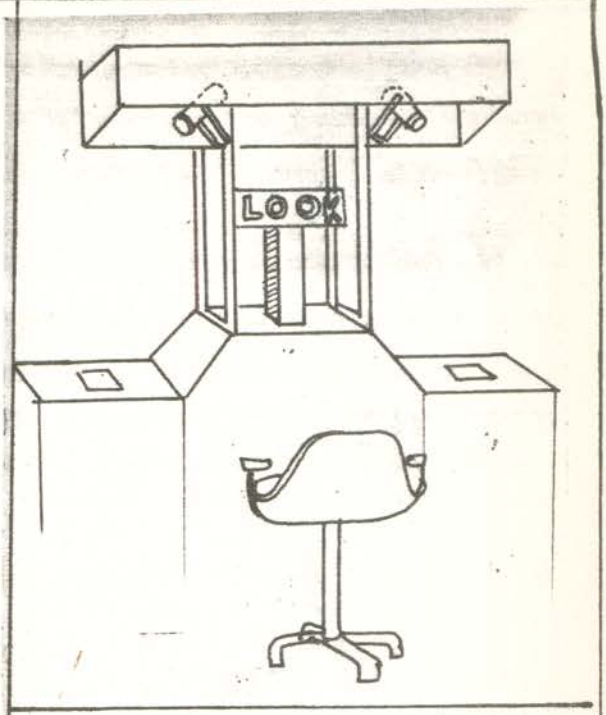
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
7	WORLD OF EYES	COLOUR BOUNDARY
ALL DIMENSIONS IN C.M.		

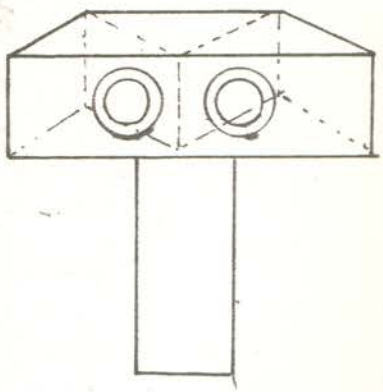
From a distance, objects look two-dimensional. A two-dimensional object may look convex or concave on the basis of our daily experience but our eye and brain rely on and see both faces as convex.

ILLUSIVE CUBES

Look at the cubes from the observation point. Move sideways, the cubes rotate. A cubical outline can be interpreted though there are some concave corners in this exhibit. These cut-outs contain only three faces of a cube which are obtuse at outer corners to match the perspective view from a distance. The illusion of a solid cube and distinct boundary is reinforced by the different degrees of lighting on three faces.





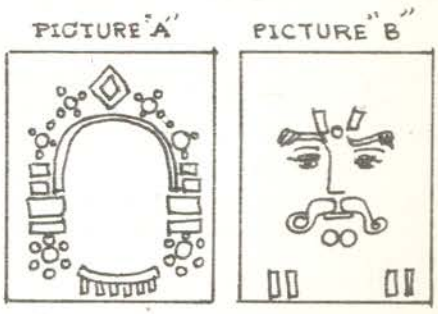


COMBINED VISION

Keep one picture card (bearing the same number) each on the marked space on both sides and look through the viewing hole (LOOK).

Two picture cards are independently seen by two eyes through the right angle prisms. These two pictures are combined in the brain and we see a complete picture though there is missing information in both the picture cards.

We can also see that if blue picture card is kept on the right and yellow on the left, we see green on the combined picture. How the colours add or subtract in the brain is a complex process.



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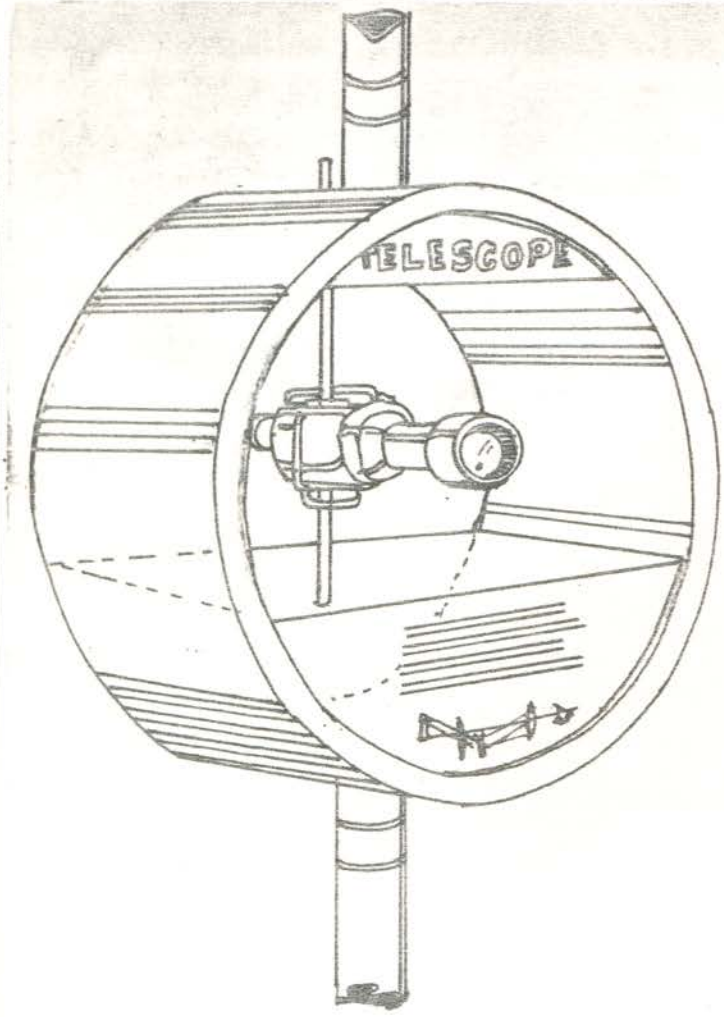
LIGHT & SIGHT

SL.NO	SECTION	TITLE
8	WORLD OF EYES	COMBINED VISION

ALL DIMENSIONS IN C.M.



TELESCOPE

This telescope gives the erect image of the object. There is an additional tube (with lens) connected to the telescope to invert the image so as to keep it erect to the viewers.

TELESCOPE (Inverted)

Look through the telescope and observe the inverted image of the distant object. Telescope is an optical instrument to view distant objects. The objective lens of the telescope focuses the nearly parallel rays of light coming from the distant object within the focal distance of the eyepiece. The eyepiece magnifies the image. The image is real but inverted.

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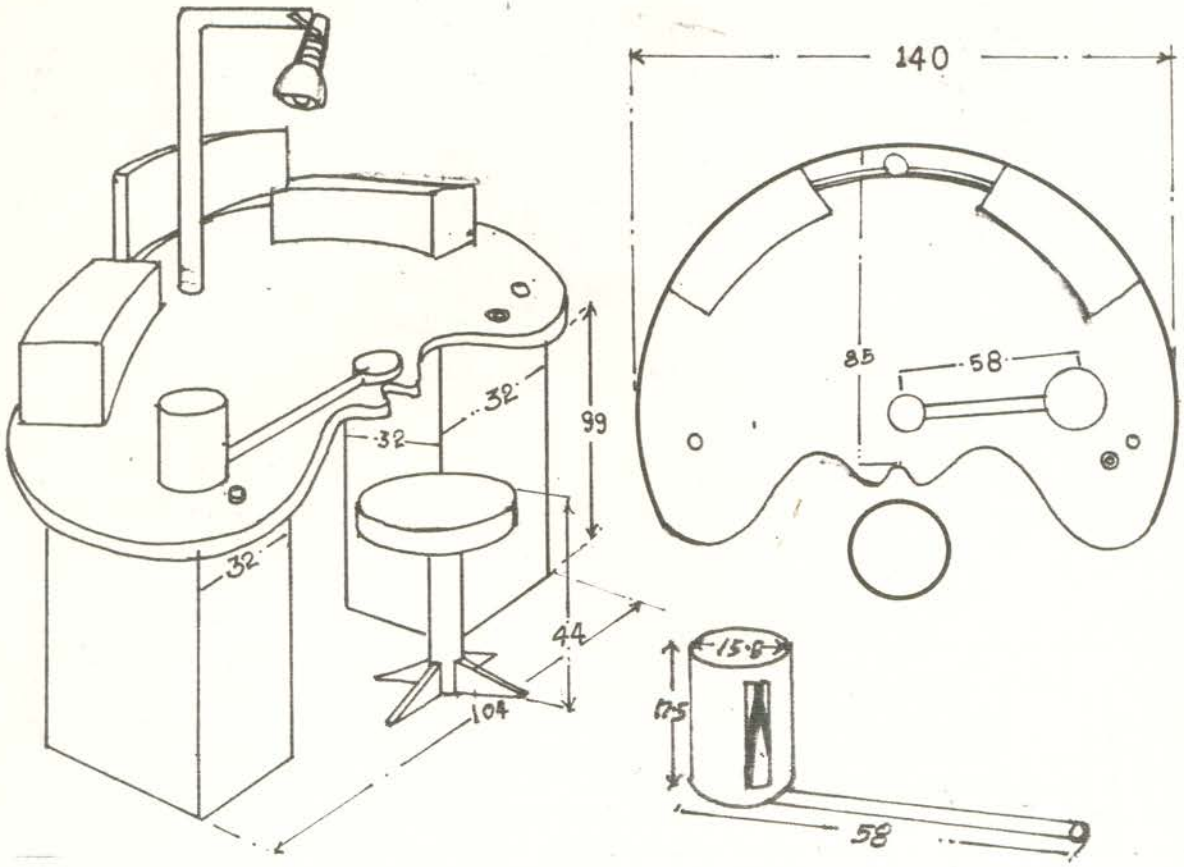
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
9	WORLD OF EYES	TELESCOPE
ALL DIMENSIONS IN C.M.		



PERIPHERAL VISION

Focus your eyes on the drum keeping it in the front. Now move the drum on both sides and observe how far you can see it, keeping your eyes focussed on the previous position. Also see whether the angle of vision remains same while the drum is rotating.

In the extreme periphery or beyond certain vision angle it is difficult to see details but it is possible to detect motion. It is believed that there are cells in the eye, only sensitive to motion.

Object kept in our peripheral field can be seen clearly for colour, shape and movement but details are fuzzy. Beyond peripheral field it is not possible.

The peripheral field size varies from person to person.

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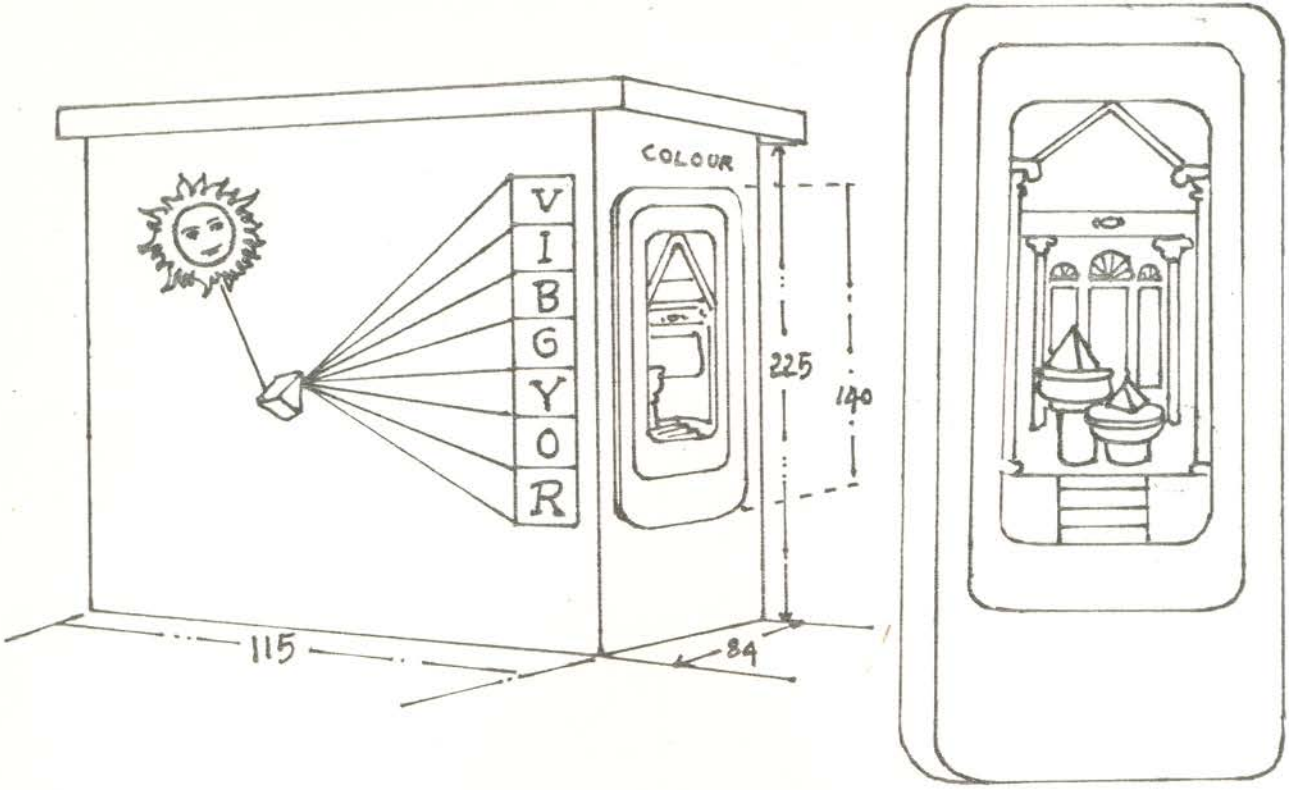
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
10	WORLD OF EYES	PERIPHERAL VISION
ALL DIMENSIONS IN C.M.		

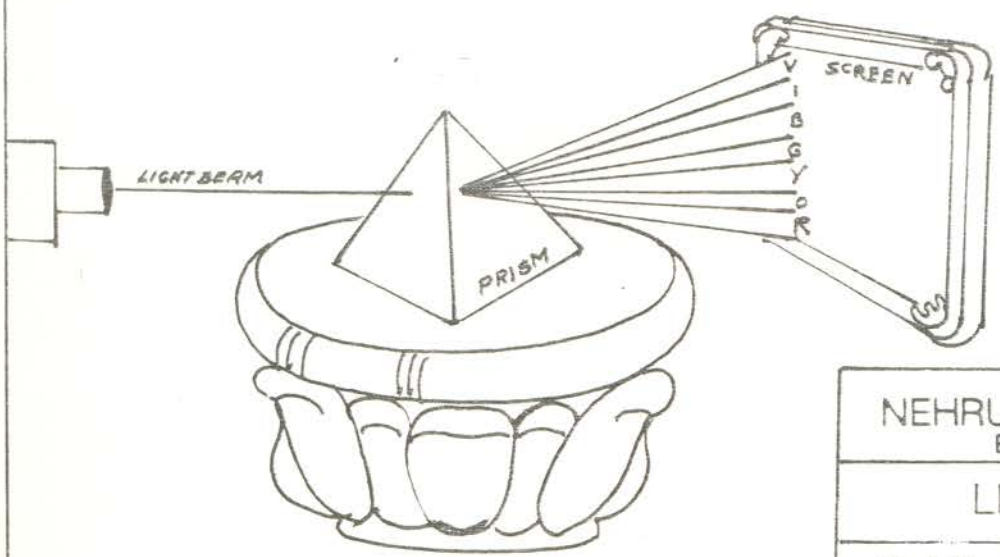


Front view

COLOURS

White light consists of seven colours. A glass prism can separate white light into seven component colours - violet, indigo, blue, green, yellow, orange & red, also known as VIBGYOR. This phenomenon is known as dispersion. In case of rainbow, dispersion is caused by raindrops.

Splitting of white light into seven colours is due to different bending capacities of different colours (wave lengths) in glass medium. Violet bends maximum and red minimum.



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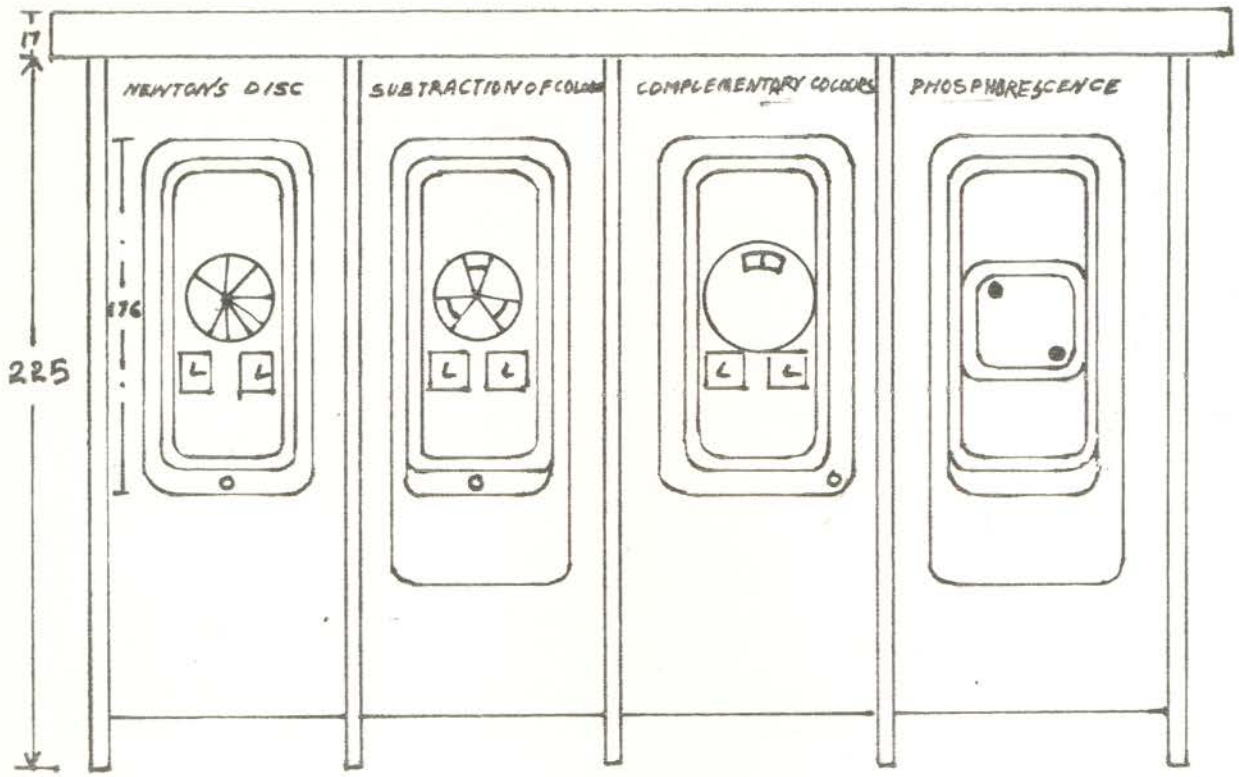
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
11	WORLD OF COLOURS	COLOURS
ALL DIMENSIONS IN C.M.		



NEWTON'S DISC

Look at the disc containing seven colour sectors in certain proportions. Press the switch to rotate the disc. It looks white. Sunlight consists of seven colours. If these seven colours are mixed in the same proportion as they are present in sunlight, we get white light.

Sir Isaac Newton was the first to find the seven colours of sunlight.

SUBTRACTION OF COLOURS

Three primary colours red, blue and green if suitably mixed can give all the colours. Similarly the subtraction of the three colours is also possible.

If yellow is subtracted from red, orange is obtained and if yellow is subtracted from blue, green is obtained.

Press the switch and watch the subtraction.

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LIGHT & SIGHT		
SL.NO	SECTION	TITLE
12	WORLD OF Colours	NEWTON'S DISC
ALL DIMENSIONS IN C.M.		

COMPLEMENTARY COLOURS

Look intently at the red light as long as it is on. The moment it is off you see a green spot. Do the same for the green; you will see a purple spot. This reversed colour is known as complementary colour.

The colour which would activate the still not activated part of the perception for colour, is called complementary colour.

The complementary colour pair gives white on addition and black on subtraction. Such as, if purple is added to green we get white and if it is subtracted we get black.

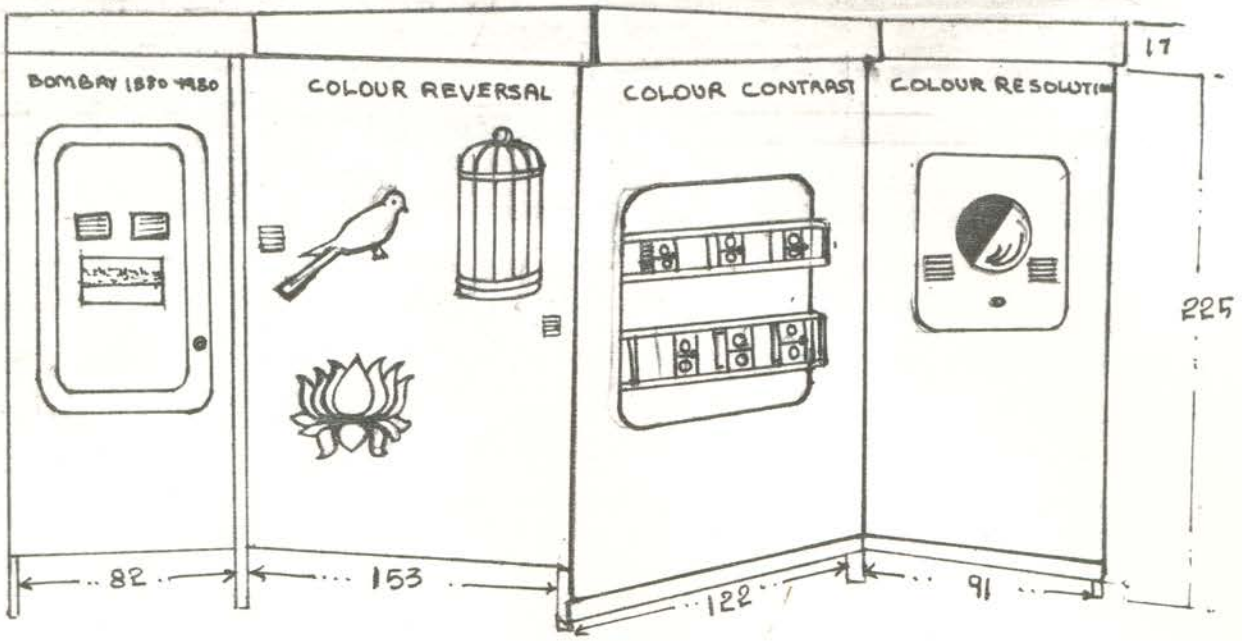
Complementary pairs:

blue - yellow
purple - green
red - light blue

PHOSPHORESCENCE

Press the switch and peep through the hole. A portrait of Sir Isaac Newton is seen. Release the button. The portrait keeps on glowing.

Some substances continue to glow even after the incident light is put off. The electrons in such substances go to higher energy level due to absorption of light energy. This energy is released by the falling electrons in the form of visible light in steps. This phenomenon is termed as phosphorescence.



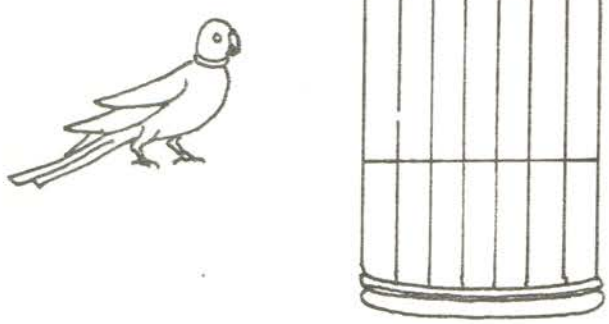
BOMBAY 1880-1980

Look through the viewing window to see the 1980 view of Bombay's Marine Drive. Press the switch. It turns to 1880. What a change !

This is possible through a partially silvered mirror. If the light behind this mirror is sufficient, it acts like a plain glass and we see the 1980 scene of Bombay. If it is not, as it is done by switching off the light, it acts like a mirror and we see the 1880 scene of Bombay kept below.

COLOUR REVERSAL

Look constantly at the blue bird for five seconds. Shift the view suddenly to the cage on the right. A light yellow bird is perceived in the cage. Similarly below, light green lotus is seen. These are called complementary colours.



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NEHRU SCIENCE CENTRE
BOMBAY. N.C.S.M.

LIGHT & SIGHT

SL.NO	SECTION	TITLE
13	WORLD OF COLOURS	BOMBAY 1880-1980

ALL DIMENSIONS IN C.M.

COLOUR CONTRAST

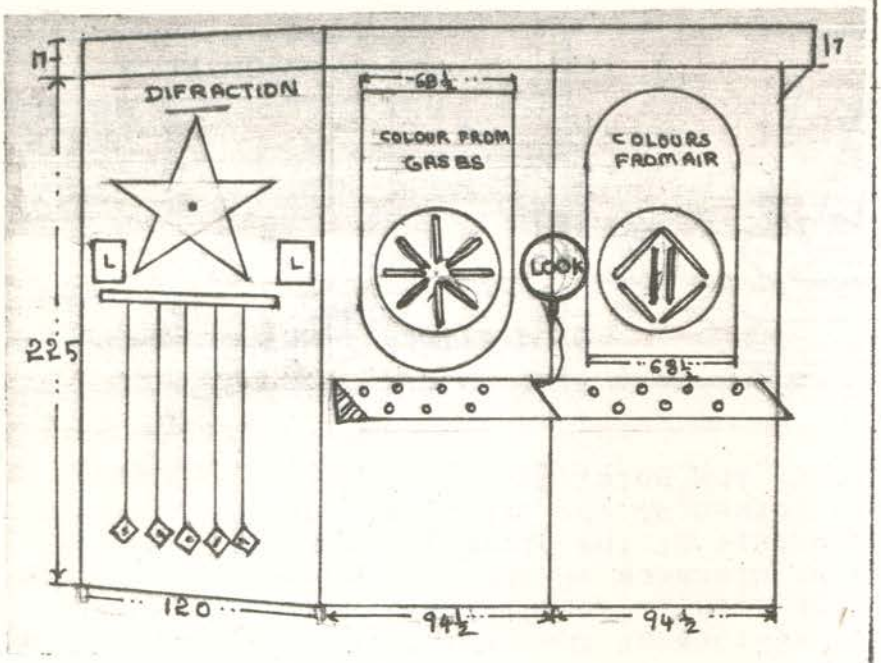
Turn the discs and bring the rectangular slot on the colour patch behind and observe the colour. Now bring two circular holes on the same colour patch. The colours now look different under two different colour circles due to contrast.

This change in appearance of colour under the influence of another colour is known as colour contrast.

Here, the colour patch, behind the hole within the small circular colour backgrounds, is viewed under the surroundings of different colour areas and the same colour looks different due to colour contrast.

COLOUR RESOLUTION

Press the switch and see the colour rings on the disc. Our eye detects colours because of colour receptors. The difference in relaxation time of different colour receptors in the eye and their response to lateral inhibition leads to the perception of colours along the edges of rings which are seen due to persistence of vision. This effect was first observed by Benham.



DIFFRACTION

Look at the point light source using any of the hanging viewers. Some viewers give bright & dark bands & some give colours. At the edge of a slit light bends due to its wavy nature. This phenomenon is called diffraction. Light diffracts at the edges of a slit and an interference pattern is formed giving dark and bright bands. Large number of slits, very close to each other break, passing white light into rainbow colours. Diffraction grating & nylon cloth of very fine mesh give similar effect.

Diffraction gratings are used to identify various elements by analyzing their spectrum. Similarly, motion of stars is also determined by observing their spectral change.

COLOUR FROM GASES

Press the switches corresponding to each gas and see the colours they give on glow. Hold the grating in front of your eyes and see the colour line spectrum of the light.

When high voltage is applied across the two ends of a tube containing gas, the gas starts ionising and gives visible light. The colour of light is characteristic of the gas and pressure.

COLOUR FROM AIR

Press the switches corresponding to air at 2 mm, 4 mm, 6 mm & 10 mm pressure & observe the colour of glow.

Air discharges at very high voltage & emits a characteristic colour. Colour of glow depends on the voltage & pressure of the gas.

Look through the grating to see the continuous spectrum of the emitted light.

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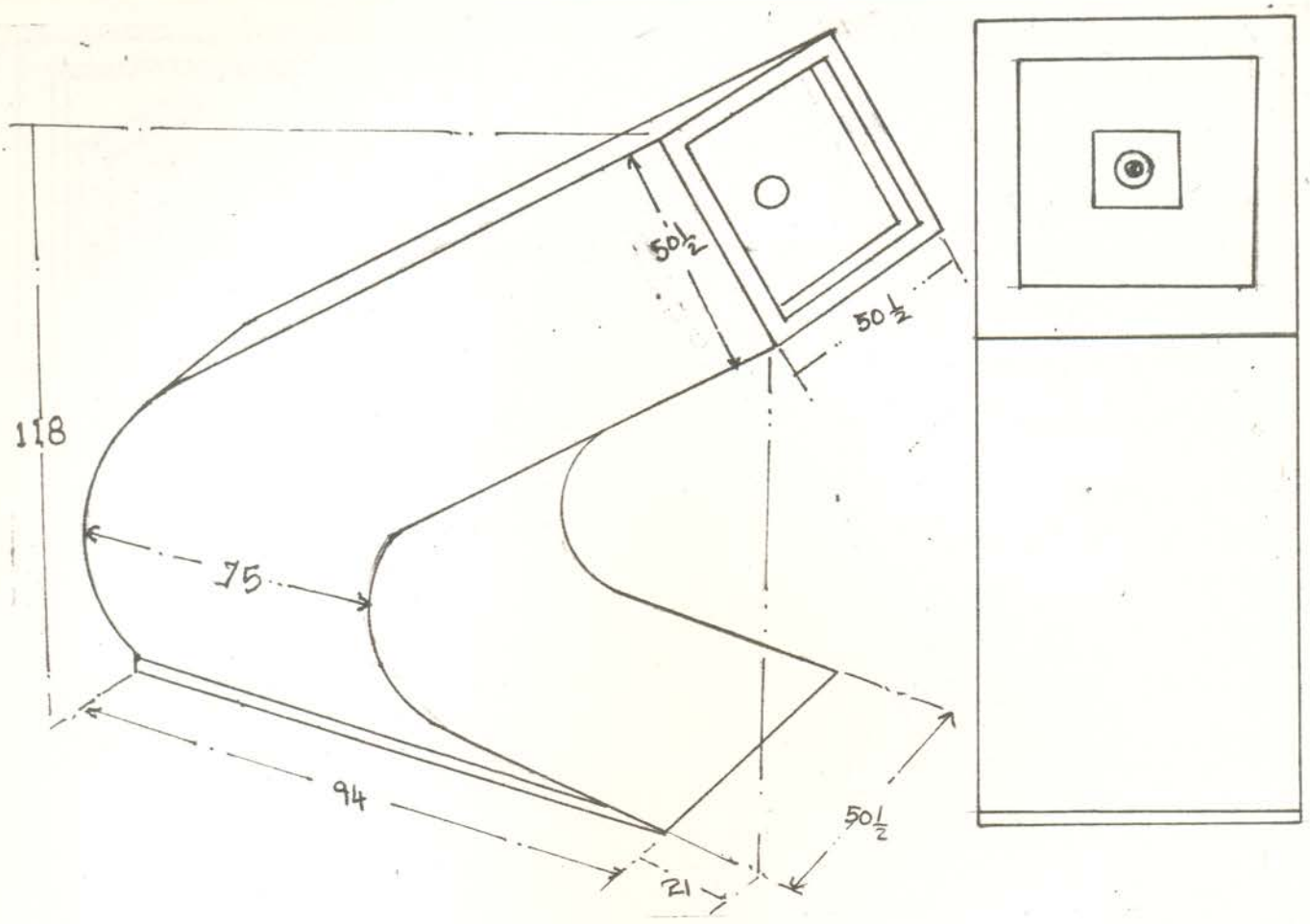
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
13 A	WORLD OF COLOURS	
ALL DIMENSIONS IN C.M.		

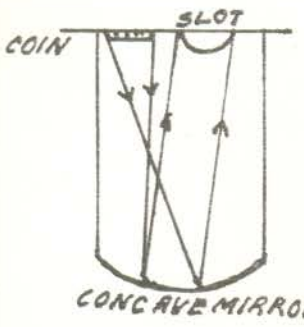


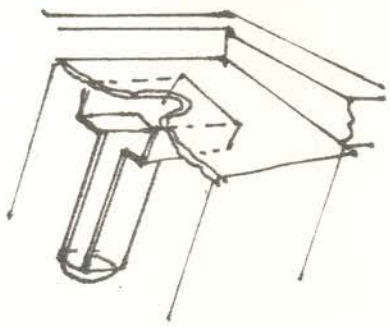
CATCH THE COIN

Catch the floating rupee coin. Can you ? The coin always eludes you.

Mirrors can make an image float in space. The image of an object placed at the centre of curvature of a concave mirror is formed at the centre of curvature itself. It is real but inverted.

Here the centre of curvature of the mirror is just below the hole and the coin is kept a little aside the window keeping the distance of the coin equal to the radius of curvature of the mirror. The real image of the coin is formed at the window giving the illusion of the coin at the hole.





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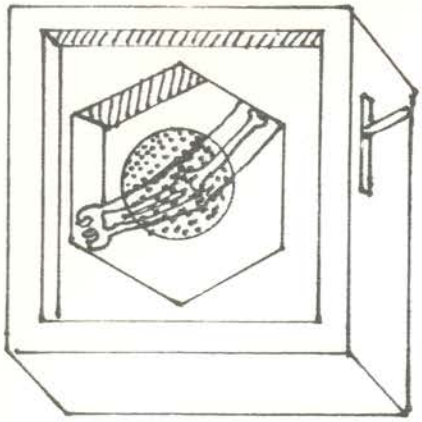
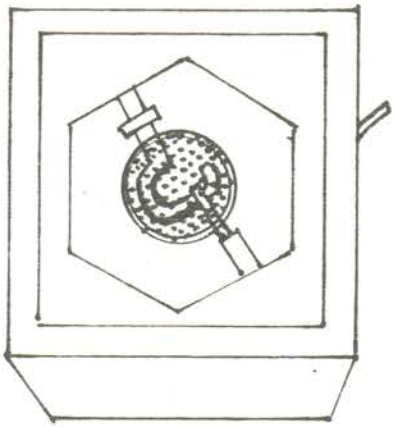
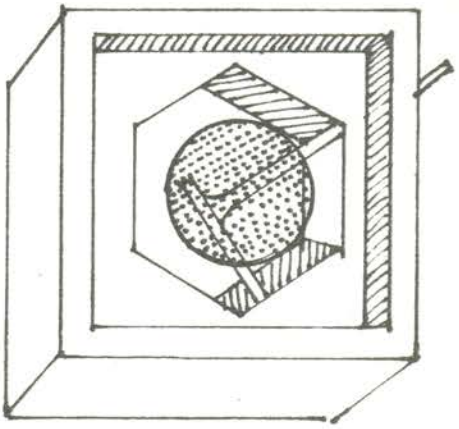
LIGHT & SIGHT

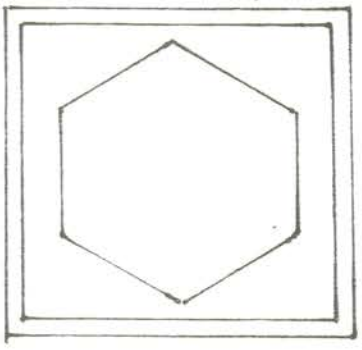
SL.NO	SECTION	TITLE
14		CATCH THE COIN

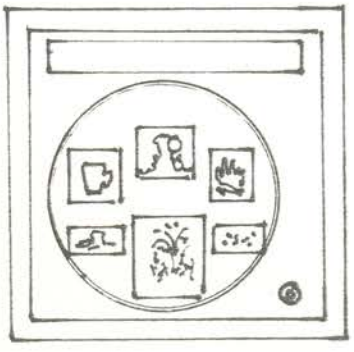
ALL DIMENSIONS IN C.M.









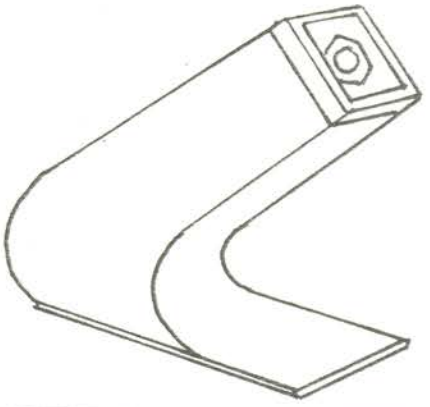


STRESS PATTERN

Pull the handle down and see the light pattern on the plexiglass shapes. The light intensity is not the same and coloured light patterns are seen at some portions.

Stress can twist polarised light into colours when it puts pressure on plastic molecules. The colours of lights that emerge indicate the amount of stress applied.

The lines of stress in the similar shape of iron or other opaque objects act similarly. This is how the stress patterns are visualized before the actual designs of structures.



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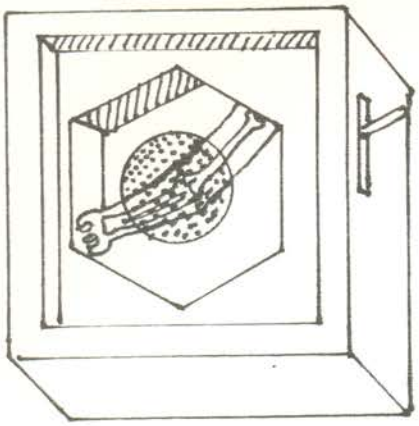
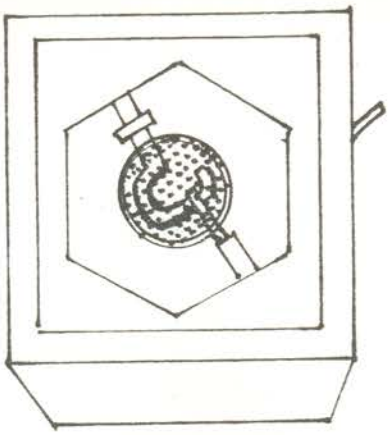
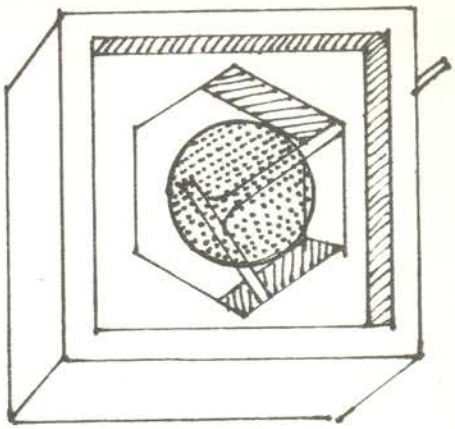
LIGHT & SIGHT

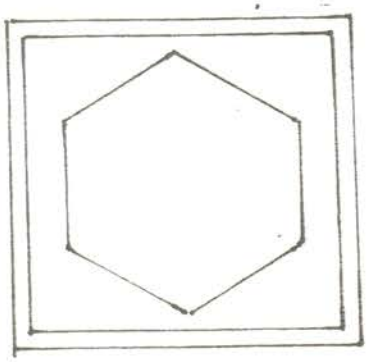
SL.NO	SECTION	TITLE
15		STRESS PATTERN

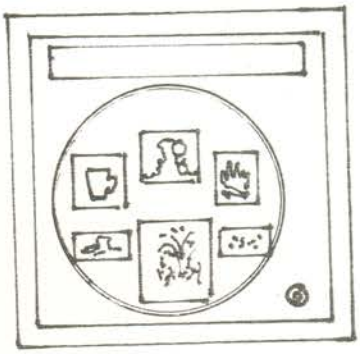
ALL DIMENSIONS IN C.M.











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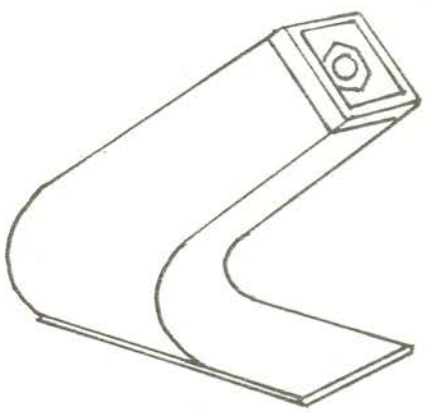

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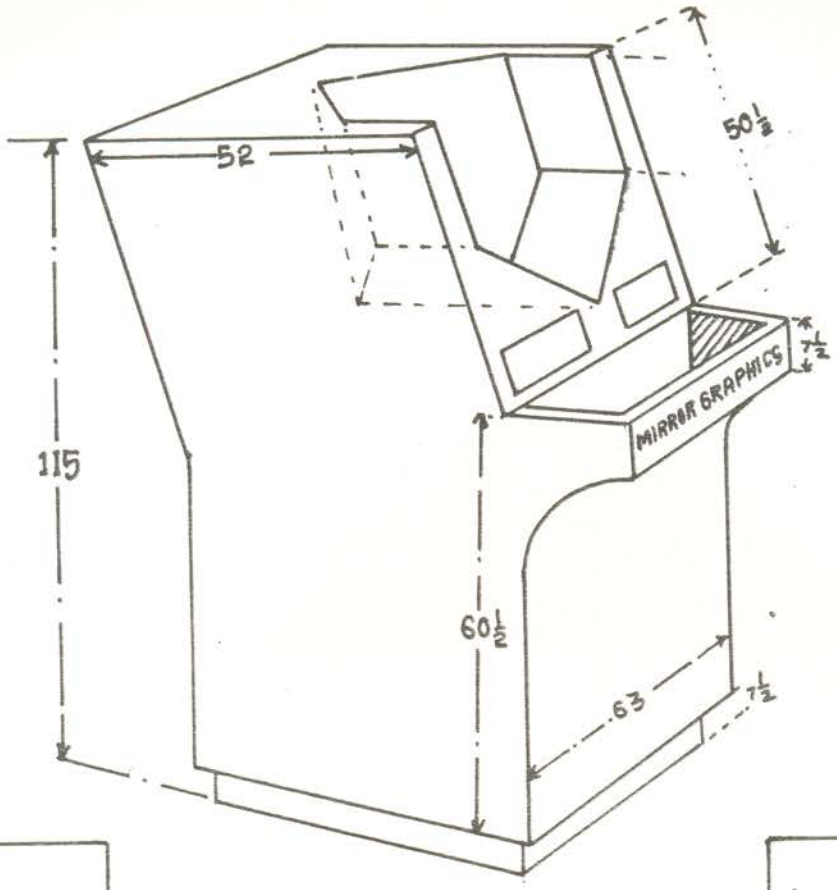
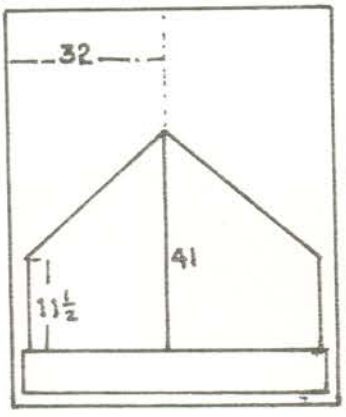
LIGHT & SIGHT

SL.NO	SECTION	TITLE
15		STRESS PATTERN

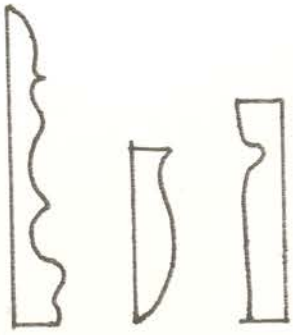
ALL DIMENSIONS IN C.M.

MIRROR GRAPHICS

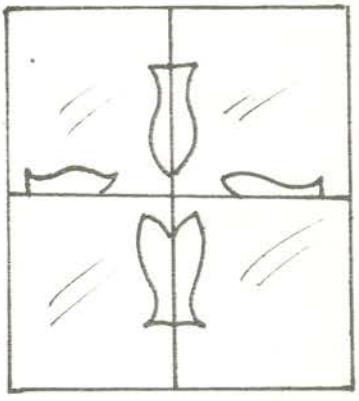




Top view



Cut-outs for mirror graphics



Design formation

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LIGHT & SIGHT		
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16	FUN WITH LIGHT	MIRROR GRAPHICS
ALL DIMENSIONS IN C.M.		

MIRROR GRAPHICS

It is a fancy kaleidoscope. This simple arrangement of four mirrors at right angles can generate three-dimensional figures of fascinating designs.

Only one rod is used to make a cube. Two rods can provide a cube inside a cube. In case of a cube formed by only one rod there is a real object making four images in four mirrors and the rest are images of images. Place the rod resting on the inclined mirrors to get the cube.

Use other cut-outs or combinations to make other figures.

A) PERISCOPE

A periscope is a simple arrangement of plane mirrors in parallel and helps you to see something on the other side of an opaque wall.

B) MICROSCOPE

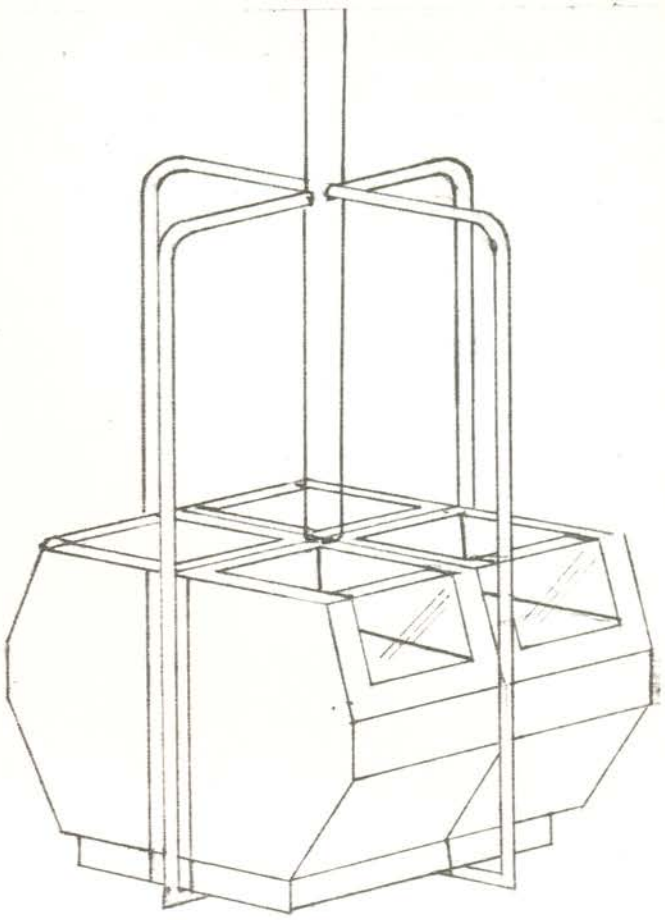
Microscope is an optical instrument to see small objects like blood cells, bacteria etc. Simple arrangement of lenses magnifies the image of the object.

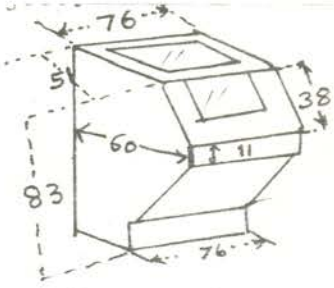
C) BINOCULAR MICROSCOPE

A binocular microscope consisting of a pair of compound microscopes, is used to have a three-dimensional look at the object.

D) PRISM BINOCULARS

Prism binoculars are nothing but a pair of low magnification telescopes, in each of which the light is reflected up and down the tube by prisms as shown. One prism inverts in a horizontal plane (left to right) and the other in a vertical plane (top to bottom) so that the final image is oriented in the same way as the object.





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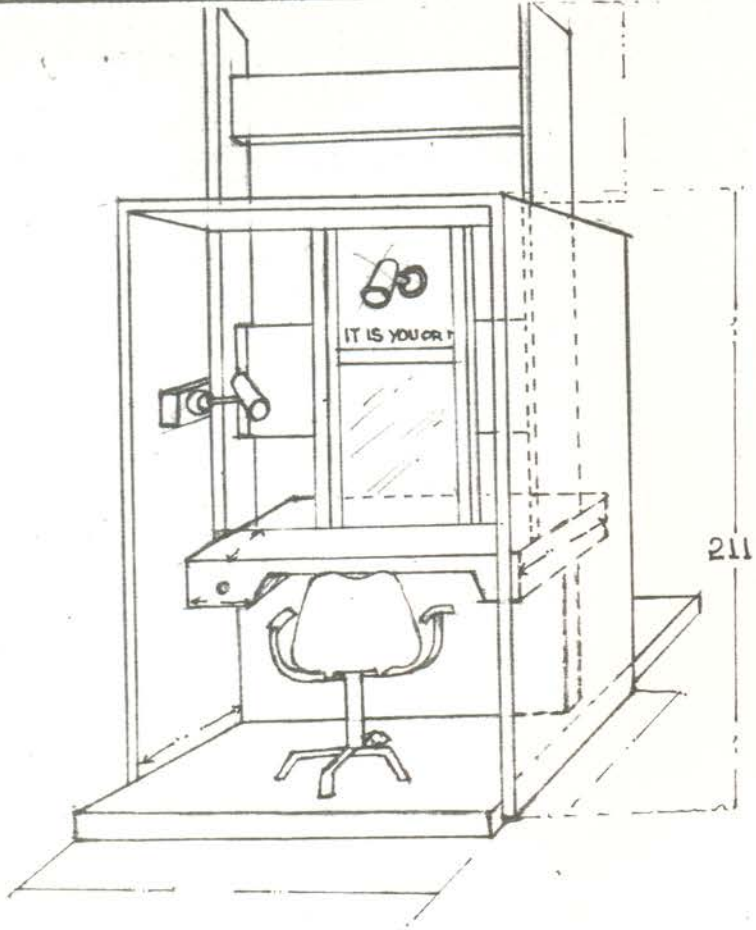
17		
ALL DIMENSIONS IN C.M.		



IS IT YOU OR ME ?

Sit on any chair and ask your friend to occupy the chair on the other side. 1. Control the front lights, one by one of other side by the knobs to your right. Ask your friend to do the same and observe your image on the glass. Your image and the face of your friend on the other side superimpose and a funny image is seen. 2. Turn off the front light and control the side lights by knobs on the left. Now your half image and half image of your friend are seen superimposed.

A glass can act as a transparent medium as well as a reflecting surface depending upon the conditions of illumination on either side. Any surface cannot be fully transmitting or reflecting. Here the special glass behaves like a mirror if there is no light on other side. It behaves like a transparent glass if there is sufficient light on other side. In case of front light control the images and real face on other side will superimpose at some condition of illumination. Similarly if left face (right in the mirror) is illuminated at one side and left face on other side, the result will be half of each person in the image.

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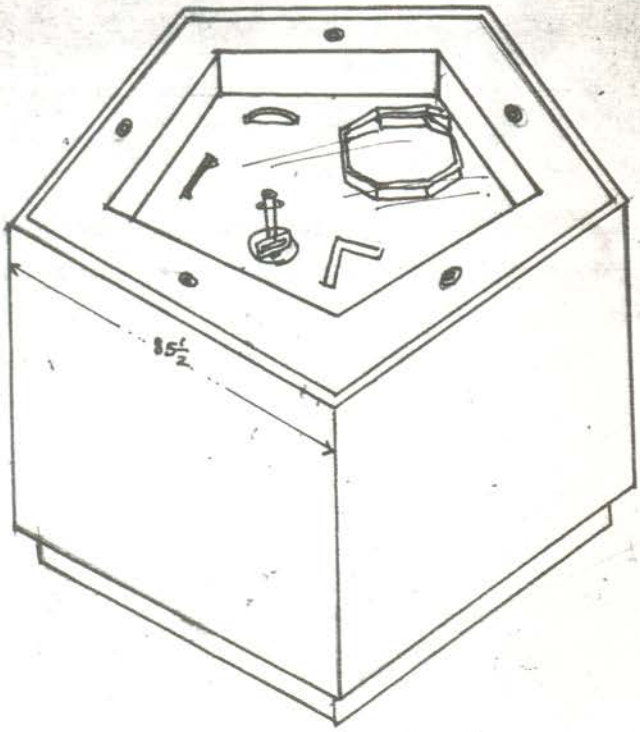
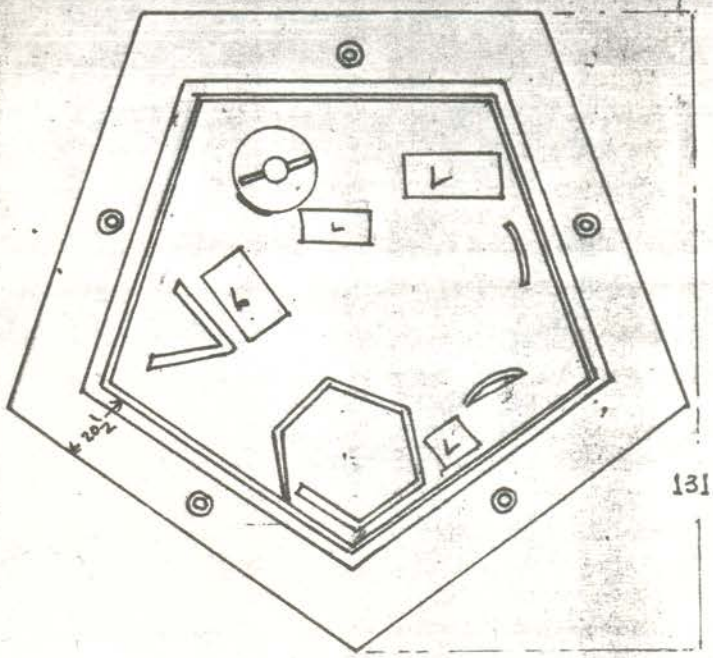
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
18		IS IT YOU OR ME ?
ALL DIMENSIONS IN C.M.		





REFLECTIONS

Ordinary mirrors always absorb some light when they reflect. Also a narrow light beam diverges as it travels. Therefore, in practice, an infinite number of reflections is not possible with an ordinary mirror.

If light falls on a plane mirror at a certain angle, the reflected ray makes the same angle. Rotate the knob and see.

A convex mirror makes a parallel beam of light diverge on reflection.

Change the angle of incidence and see what happens.

Concave mirror converges parallel beam of light to a point called focus.

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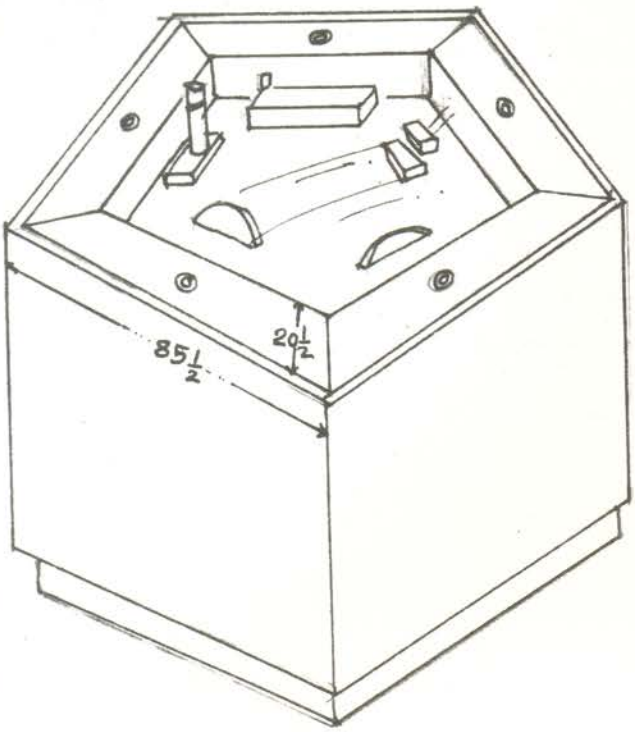
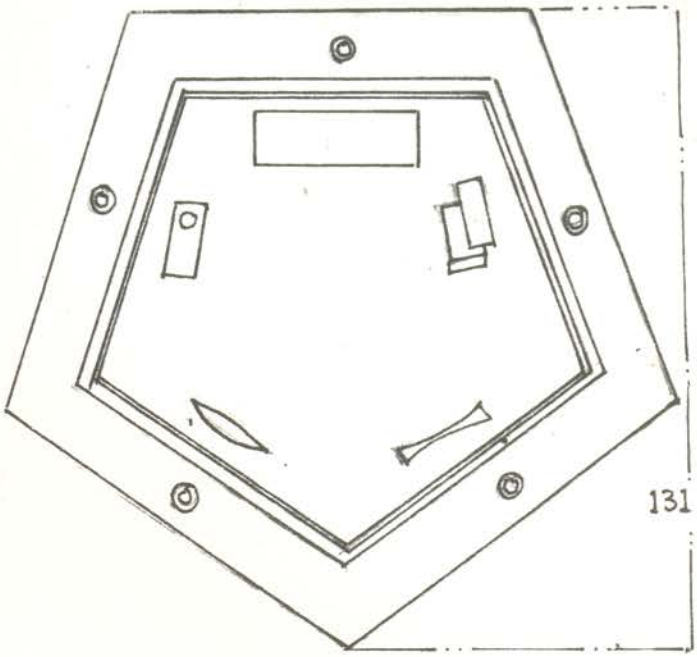
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
19		REFLEC-TIONS
ALL DIMENSIONS IN C.M.		





REFRACTION

When light changes medium, it bends. This property is called refraction.

Light moving from a dense to rare medium gets fully reflected when it makes a suitable angle with the surface.

Convex Lens converges parallel rays to a point called its focus.

Concave lens makes parallel rays diverge.

In different media light bends differently.

REFRACTION

1) Transparent Box
2) Glass Rod
3) Convex Lens
4) Concave Lens
5) Twin Blocks

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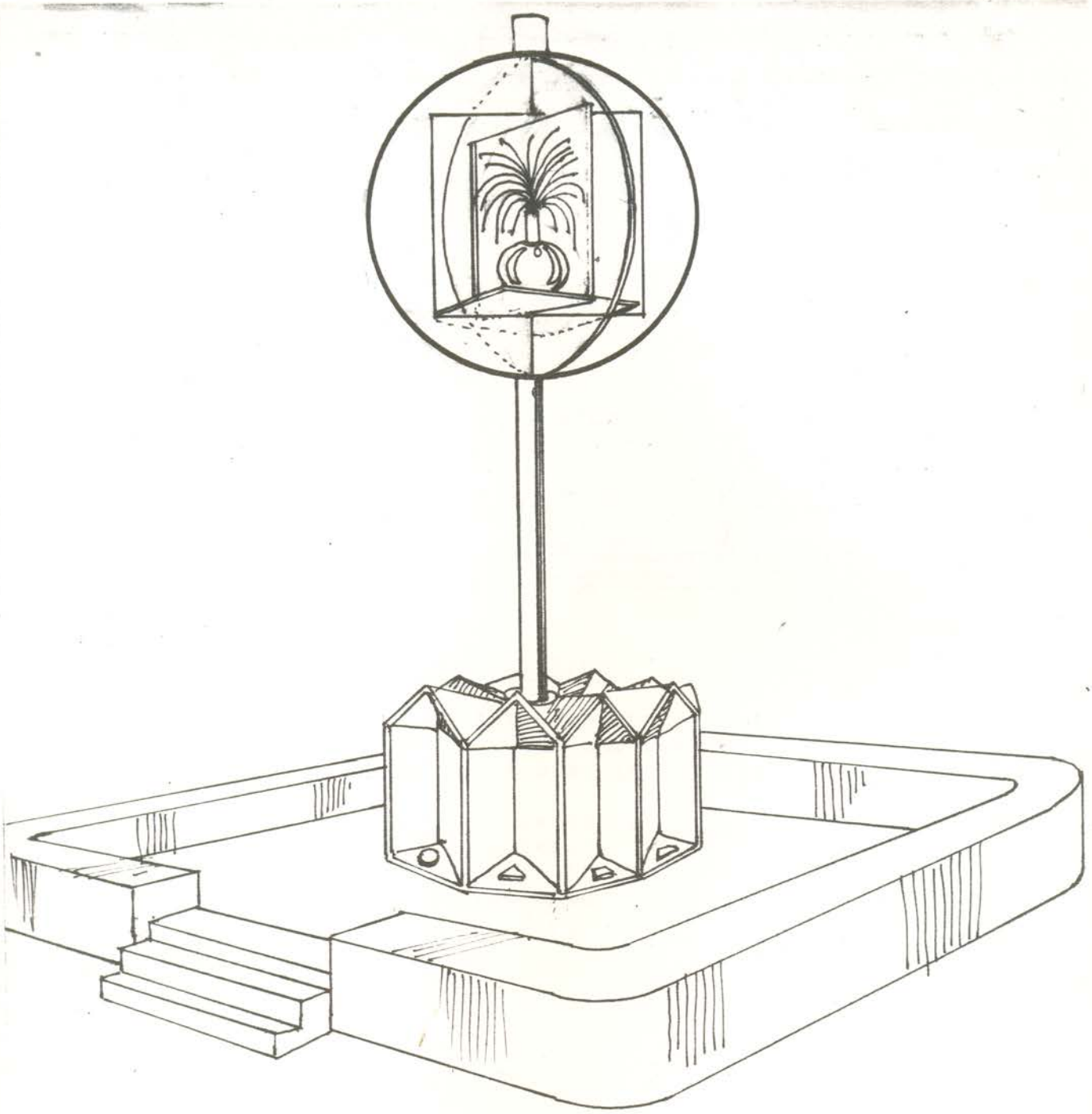
LIGHT & SIGHT

SL.NO	SECTION	TITLE
19 A	FUN WITH LIGHT	REFRACTION

ALL DIMENSIONS IN C.M.



OPTICAL FIBRES

Look at the tips of fibre-like rods. Light can propagate inside these fibres. These are called optical fibres.

Optical fibres work on the principle of total internal reflection, the property that makes light to travel along a curved path. This is possible because of the special construction and property of the material. Optical fibres have made it possible to propagate light in any curved path making optical contact.

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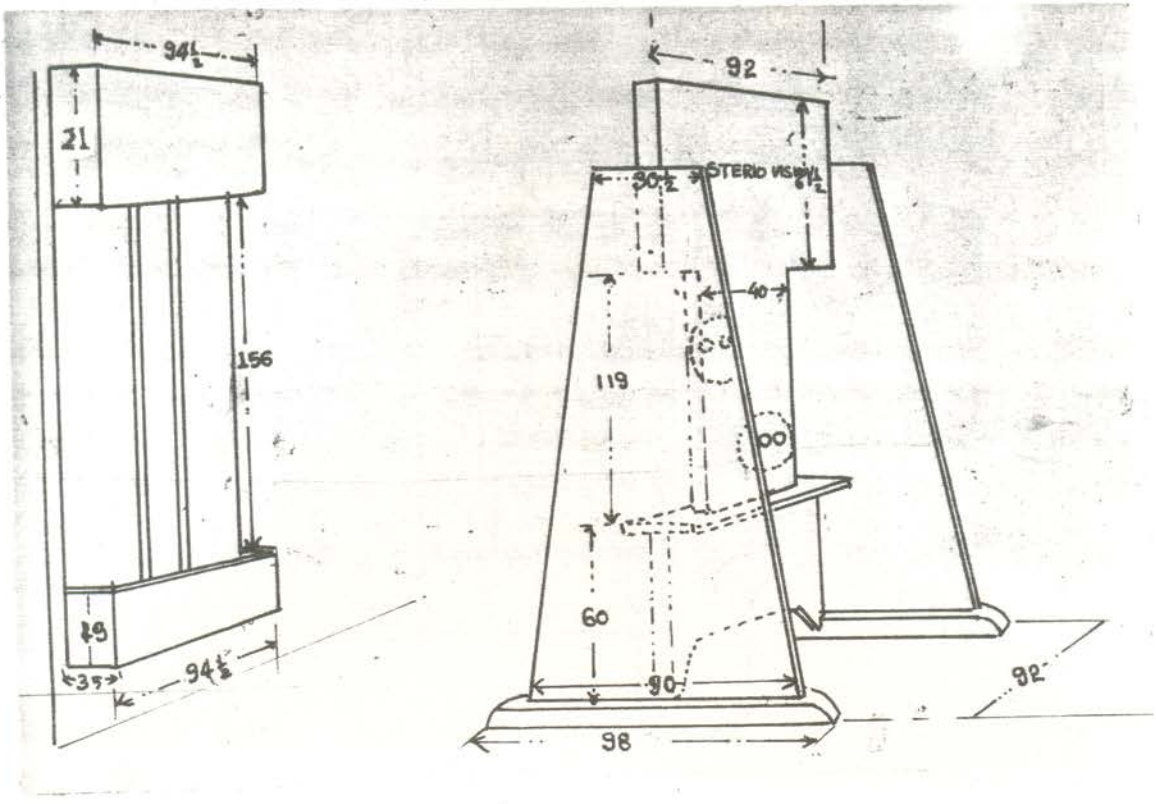
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
20		OPTICAL FIBRES
ALL DIMENSIONS IN C.M.		



STEREO VISION

Turn the disc and look through the viewing window. You get the view of two rods with one eye and two eyes alternately. Two rods in front seem to oscillate.

When we look with one eye we cannot judge the distance of the two rods from the viewer. It is possible to judge the distance with two eyes. Because of this depth perception the rod behind seems to be parallel with the front rod or go back depending upon the viewing with one eye or two eyes.

This is how two eyes, working together can inform our brain about the depth.

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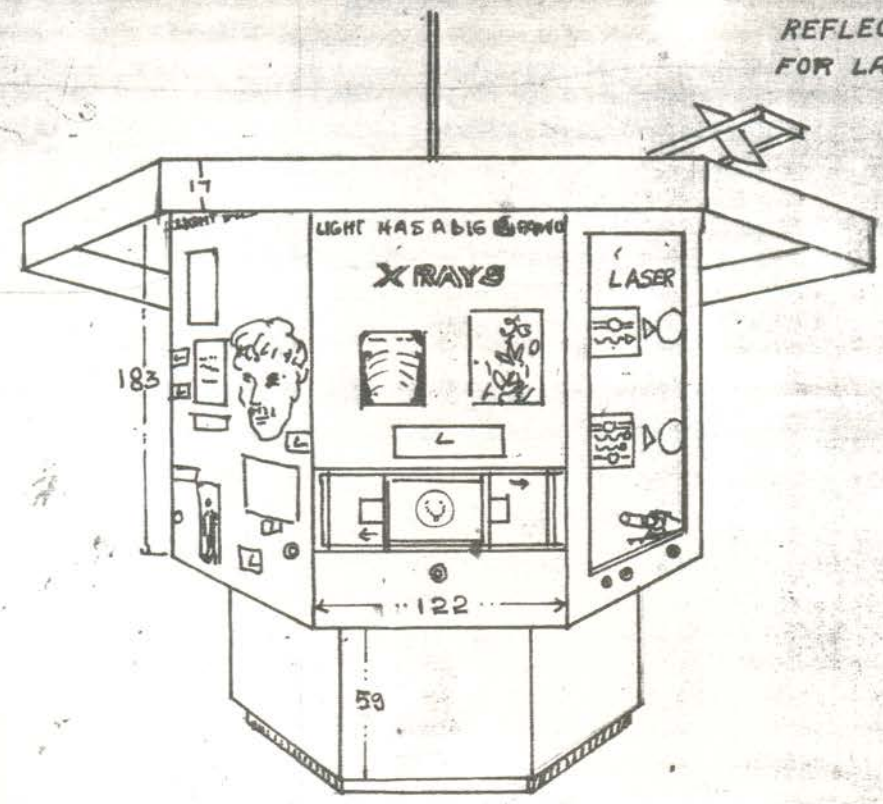
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
21		STEREO VISION
ALL DIMENSIONS IN C.M.		



RADIOACTIVITY

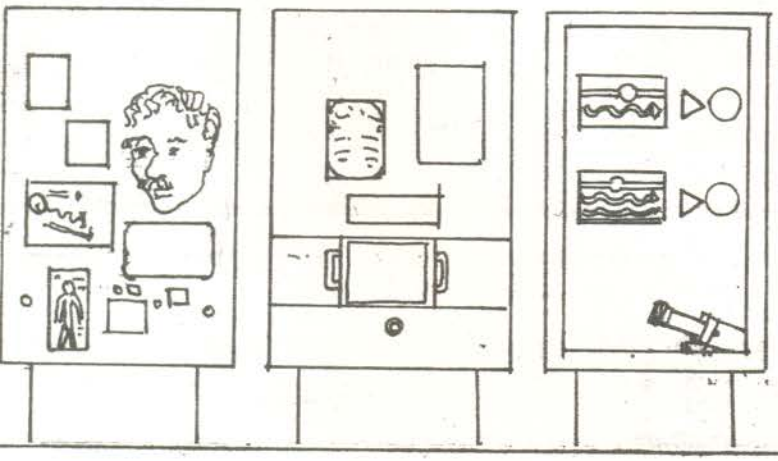
Alpha rays can be stopped by a paper. Beta rays can be stopped by a wooden board. But a lead sheet of proper thickness is necessary to stop gamma rays.

Homi Jehangir Bhabha (1909-66) of India made important contributions to the study of cosmic rays.

Antoine Henri Becquerel (1852-1908) of France discovered natural radioactivity.

Sir Ernest Rutherford's (1871-1937) researches in radioactivity and atomic structure laid the foundation for developments in nuclear physics.

If your watch glows in the dark it contains some radioactive material. Put the watch-dial in front of the hole and observe how many counts it gives in a minute.



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LIGHT & SIGHT

SL.NO	SECTION	TITLE
22	LIGHT	RADIO-ACTIVITY

ALL DIMENSIONS IN C.M.

X-Rays

Because of their very short wavelength, X-rays pass through many substances like flesh which are opaque to visible light. Thus X-ray help in photographing our bones which is very useful in medical diagnosis.

X-rays are also called Roentgen rays after their discoverer Wilhelm Conrad Roentgen (1845-1923) of Germany.

Step 1: Press switch - you see X-rays falling on a fluorescent screen.

Step 2: Slider A contains a necklace which is not normally visible. Slide A to place it before X-rays and see the necklace.

Step 3: Slide A back to original position.

Step 4: Slide B is a lead screen which stops X-rays. Slide B to place it before X-rays and observe.

Step 5: Slide B back to original position.

LASER

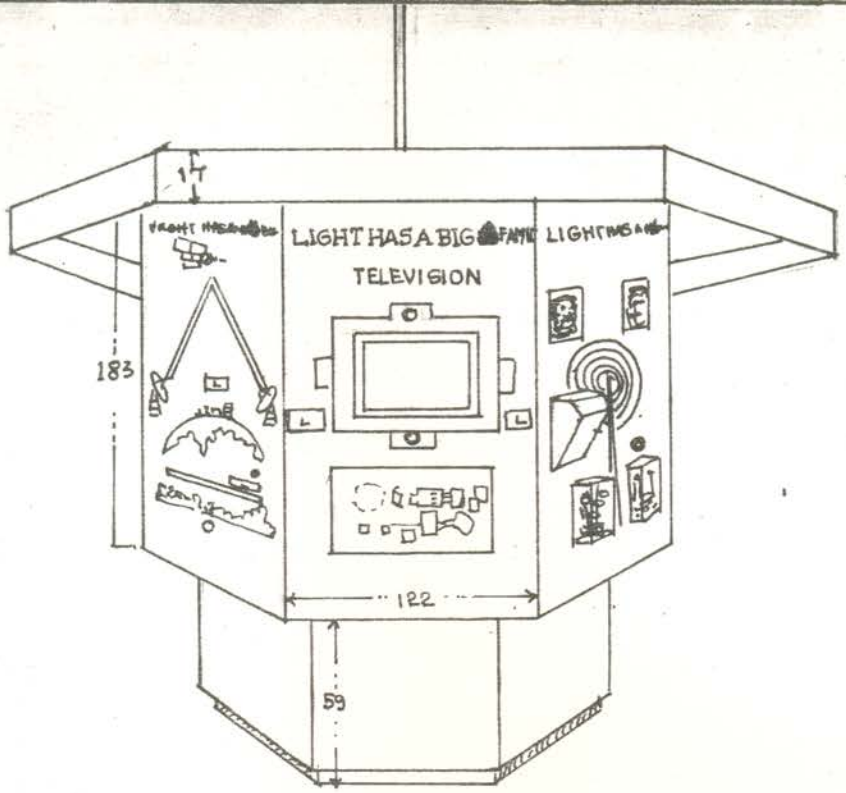
Light Amplification by Stimulated Emission of Radiation (LASER) is a coherent source of light.

Light is produced by stimulating photon emission by high energy lights or electric discharge or even nuclear radiation. The exchange of energy between incident radiation or a light photon and the atoms of substances, stimulates the emission of another photon of same wavelength by the substance and along the axis of the tube.

The resulting wave of photons (emitted & incident) is subjected to multiple reflections by the two mirrors at the ends of the tube. Ultimately, it gains intensity and flashes out from the partially silvered mirror end. This beam of light is narrow, coherent, intense and unidirectional.

Lasers have many applications in industry, military, scientific research, communication and remote sensing, because of their capacity to generate immense heat and travel long distances without much deviation.

Observe the Helium-Neon laser beam. It travels across the hall without much deviation.



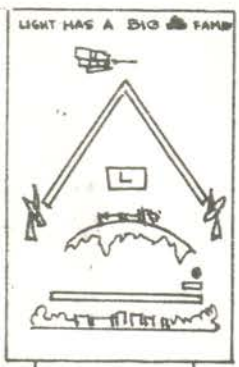
TELEVISION

Stand inside the circle to appear in the television. It is possible by closed circuit television consisting of a television camera and a monitor on which you appear. The camera converts your picture into electrical signals and sends it to the monitor. The picture tube of monitor reconverts into a picture which appears on the screen.

SATELLITE

Satellite communication is normally done by high frequency radio waves. Radio waves are also members of electromagnetic waves like light waves.

Television pictures are transmitted from television centres to television sets at home by electromagnetic waves, and it is a line of sight transmission.



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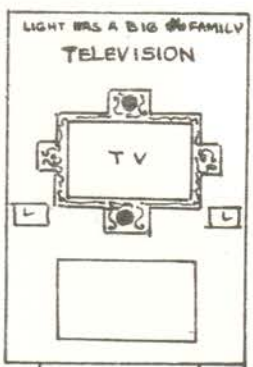

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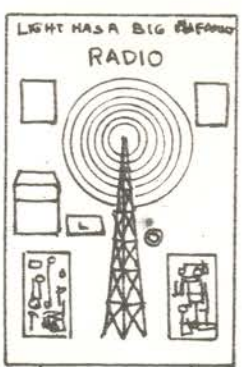

3

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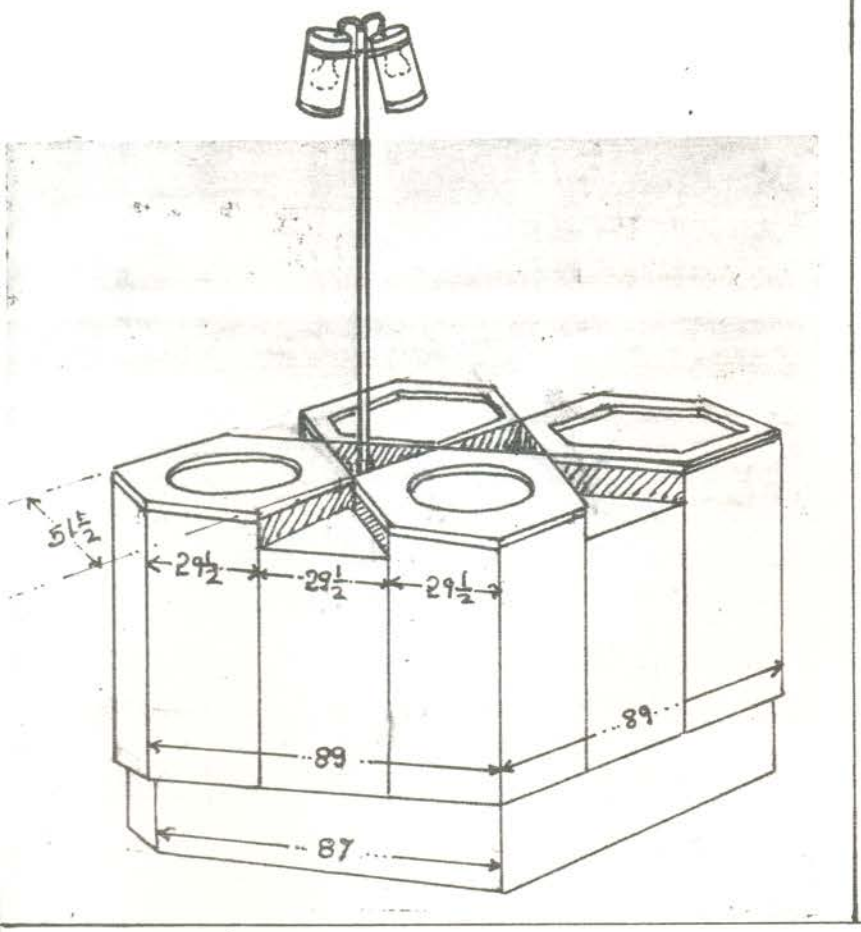
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
22A	LIGHT	TELEVISION
ALL DIMENSIONS IN C.M.		

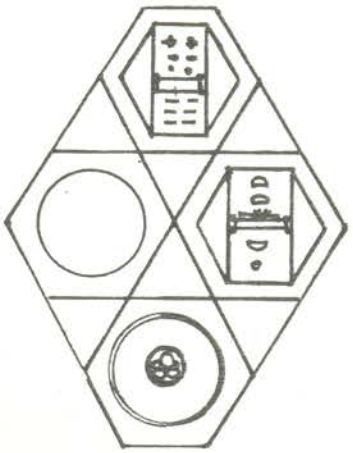
RADIO

1) Early crystal radio receiver used in India.

2) Schematic assembly of a typical valve radio receiver.

3) Schematic assembly of a typical transistor radio receiver.

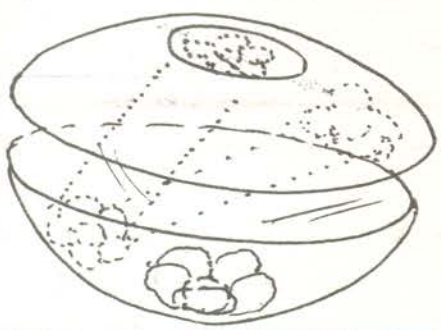




As in nature, we come across many shapes in our daily life which are symmetrical or unsymmetrical. Symmetry can be horizontal or vertical or even of any other kind. In alphabets, some letters such as I and O have both vertical as well as horizontal symmetry.

Similarly, letters - B, C, D, E, H, I, K, O, X have horizontal symmetry and A, H, I, M, O, T, U, V, W, X, Y have vertical symmetry.

Check the symmetry by sliding the rod.

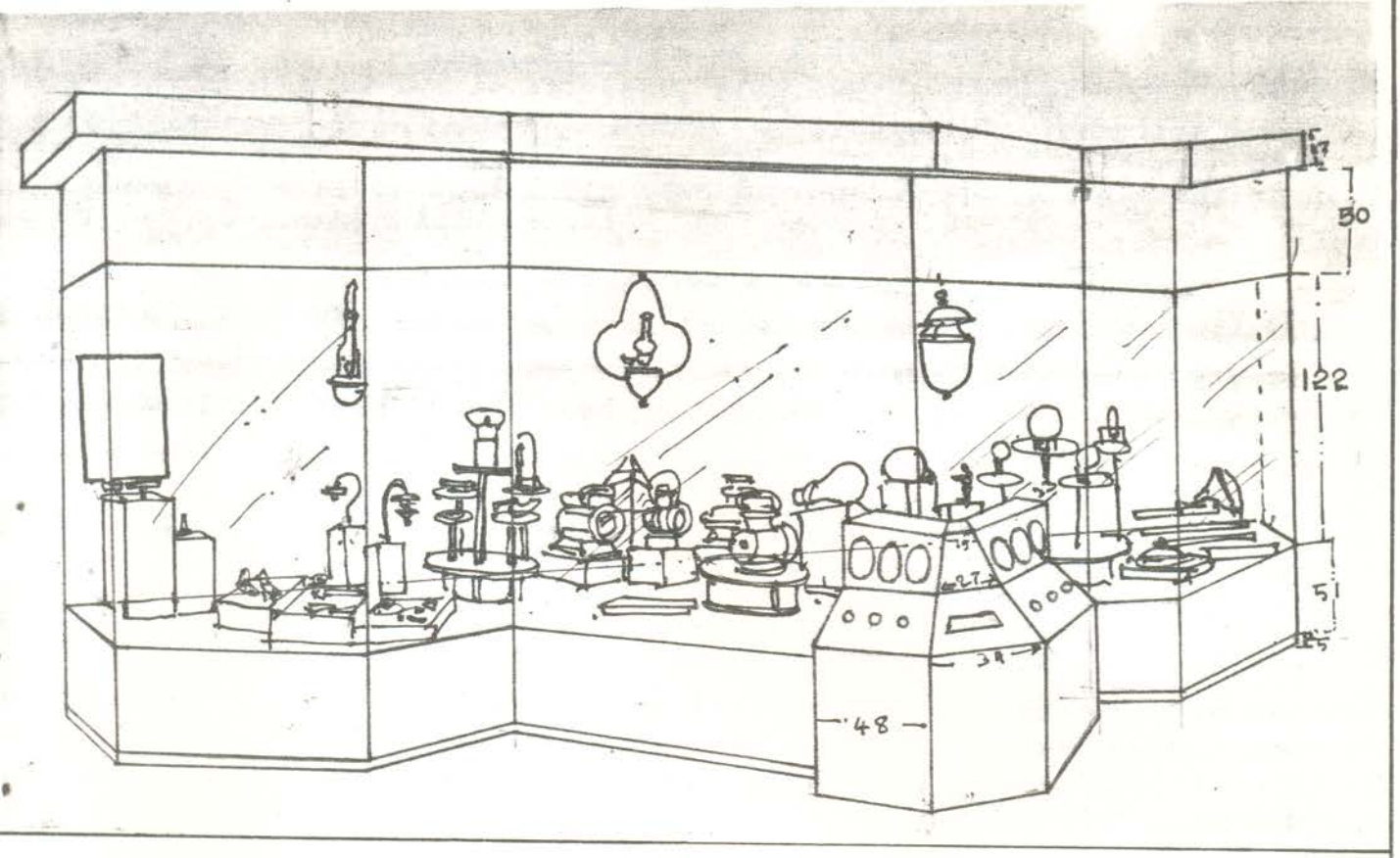


NEHRU SCIENCE CENTRE
BOMBAY. N.C.S.M.

LIGHT & SIGHT

SL.NO	SECTION	TITLE
23		SYMMETRY EXHIBIT

ALL DIMENSIONS IN C.M.



FIRE SHAW

Man first used fire in early part of old stone age. The fire-making method has not come suddenly. Man's intelligence and necessity gradually created the most convenient procedure. Fire shaw is one of the fire-making devices used in several parts of South East Asia. In this process, fire is kindled by friction.

POCKET TINDER BOXES

Domestic tinder box is one of the early fire making devices. The pocket tinder box was a different proposition. A pocket tinder box was used by the Swedish people of early 19th century. It is made up of blue steel inside which is a removable inner tube of silver with a ribbed revolving fire steel mounted alongside.

CHUCKMUCK

Chuckmuck is a kind of receptacle for tinder box used by Tibetan people in the early part of the 19th century.

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NEHRU SCIENCE CENTRE BOMBAY. N.C.S.M.		
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
24	LIGHT	WORLD OF LAMPS
ALL DIMENSIONS IN C.M.		

TINDER PISTOL (17th & 18th Cen)

Tinder pistol is one of the early fire-making devices. The earliest form introduced in late 17th century was relatively complicated "split barrel" type by triggering the spark ignited charge of gun-powder. The flame in turn ignited a piece of amadou on a spring held socket, which popped up vertical and alight.

SPECIALISED TINDER PISTOL

The bright steel pistol with an ebony handle was made in Italy in early 18th century. It is one of the fire-making devices which indicates gradually changing skill and technique. Adjacent to this is the black iron inlaid object used as toggles.

OIL LAMPS

It is guessed that the earliest lighting of all came from a wood fire. Probably man learnt the use of flintstones for making fire at a later date. Oil lamps have been found from as long ago as 3000 BC. Some of these early lamps were made from shells or from the skulls of small animals. Stone dishes and hardened clay dishes came next. When metal working came into being the lampmaker made metal lamps.

Various fats and oils were used in oil lamps. In cold countries, fat of birds, whales and fishes were used whereas in warm regions vegetable oils from linseed, mustard & coconuts were used. Butter made from cow or buffalo milk was also used. Till today these oil lamps are in vogue in religious celebrations.

LANTERNS

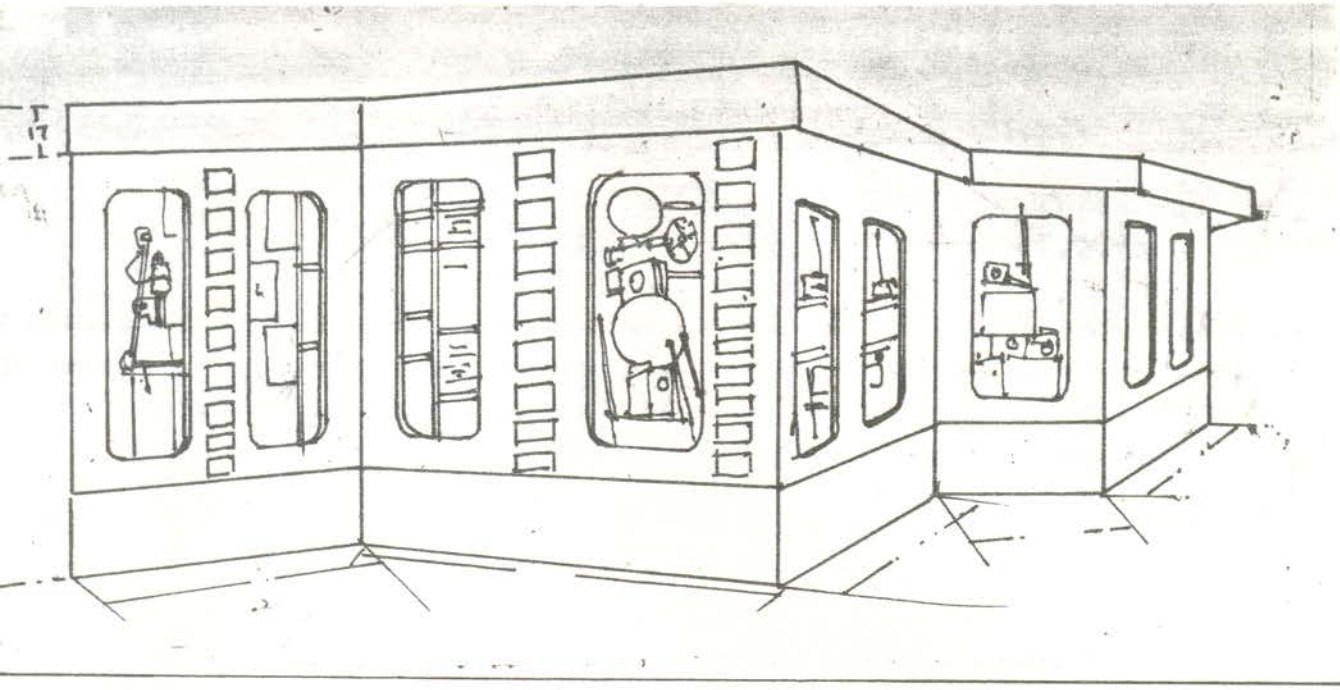
Lanterns, protective cases for lights, were common from at least the 15th century B.C. Sometimes the lantern sides were fitted with thin flakes of mica or horn. Later on, glass was used. Later lanterns had "Bull's Eyes" of glass with thick centres. They gave a spotlight effect.

In wealthier homes and in shops, restaurants & other public places elaborate lanterns were used even upto 19th century B.C. Even the other day, the railway guard who rides at the end of a long train of bogies used to swing his lantern to signal the engine.

GAS LAMP

Late in the 1700s men learned how to make gas from coal. By 1813 the Westminster Bridge in London was lit with gas. In August 1882 for the first time in Bombay a few gas lamps were experimentally installed near the old Churchgate Railway Station by the Bombay Gas Company. But this was burning gas straightaway with the help of a nozzle (burner). In 1885 Carl Auer von Welsbach (1858-1929) of Austria invented the gas mantle. A mantle is a loosely woven cotton, threads of which are filled with chemicals. With a mantle cover, a gas jet glows five times brighter.

Car headlighting was made possible in the early 1900s with the invention of acetylene gas generator.



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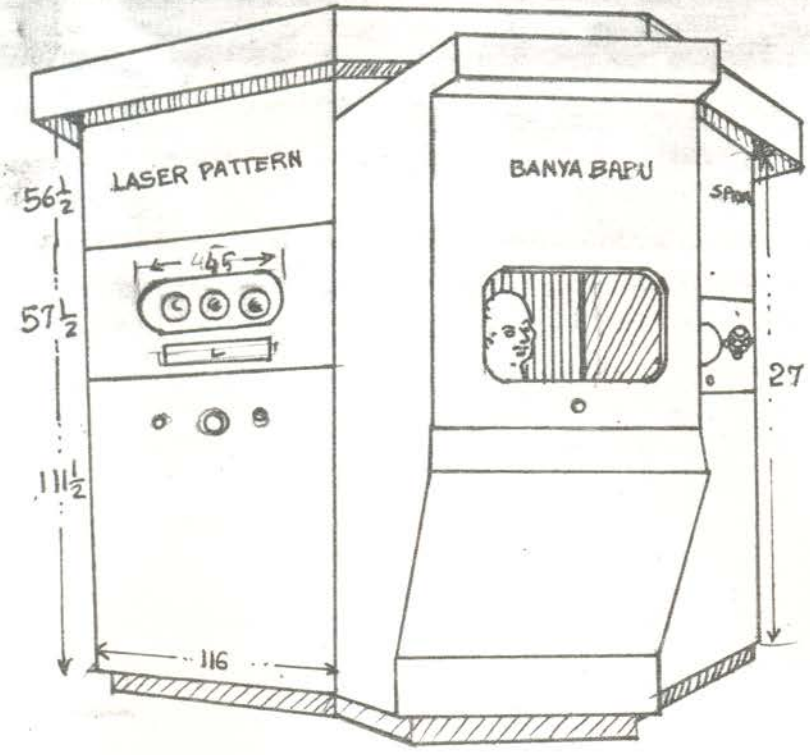
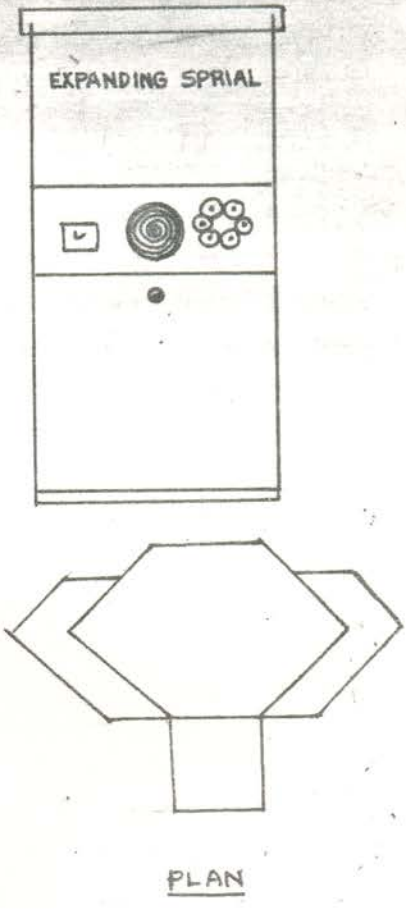
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
25	LIGHT	PHOTO-GRAPHY
ALL DIMENSIONS IN C.M.		





EXPANDING SPIRAL

Press the switch and observe the rotating spiral. It seems to be expanding.

In our eyes, there are motion detectors, different for different direction of motions. The response of these detectors is different for different kinds of motion and thereby creating an illusion of movement.

LASER PATTERNS

Turn the knob and observe the changing colours on the middle disc. Press the switches and observe the colours and the depth of the pattern on the left and right discs.

The interference pattern produced by LASER beams is superimposed on these plates. It gives rainbow colours on illumination by white light at an angle due to diffraction. Colour in the hologram is also produced in the same way.

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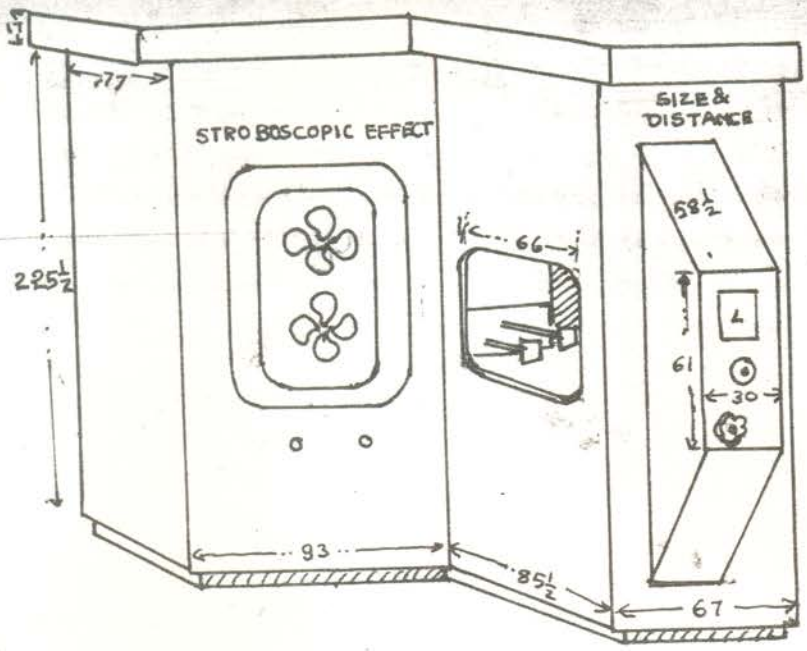
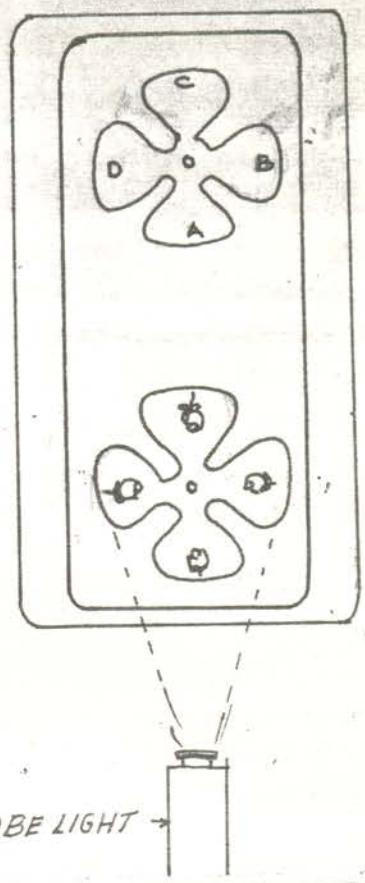
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
26		
ALL DIMENSIONS IN C.M.		



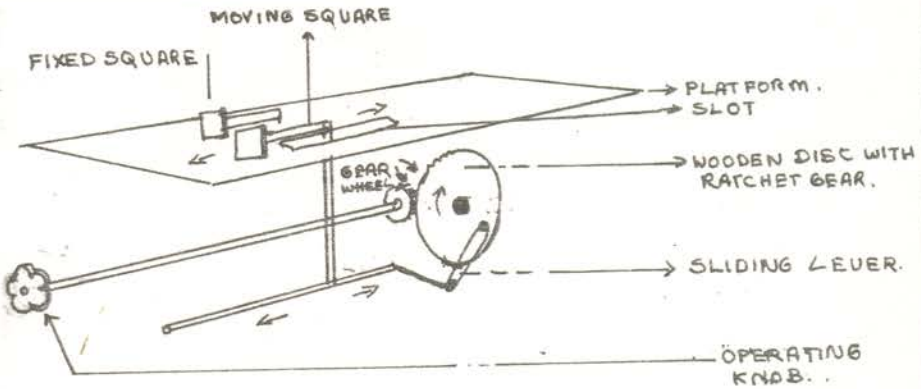


STROBOSCOPIC EFFECT

Press the left switch. The fan on the top makes one rotation with every flash of the lamp, and we see the same blade of the fan on the top every time.

Now press the switch on the right. The rotating fan seems to be stationary under the faster flashing light. The light in this case, flashes at a higher frequency nearly equal to the rotation period of the fan and the fan seems to be stationary.

If the frequency of the flashlight is changed by the knob provided, the fan seems to be rotating slower or in the opposite direction, depending upon the frequency of the flash.

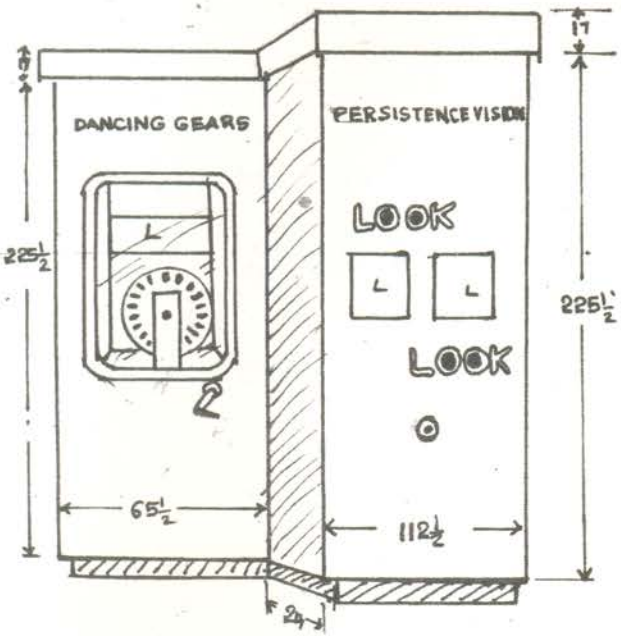


NEHRU SCIENCE CENTRE BOMBAY. N.C.S.M.		
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
27	SIGHT	STROBOSCOPIC EFFECT
ALL DIMENSIONS IN C.M.		

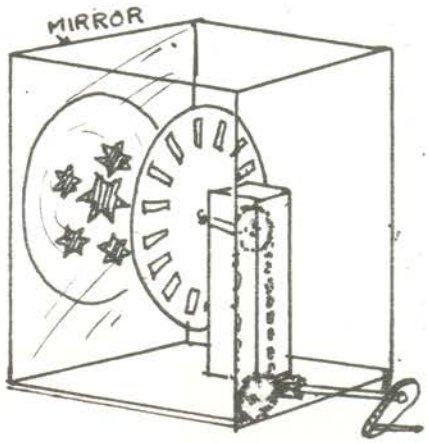
SIZE & DISTANCE

Look through the viewing hole (with one eye) and adjust the distance of two squares inside, by the knob so that they are in the same plane. Now see from the side glass window, you find that the squares are not in the same plane.

With one eye it is difficult to judge the depth and size. If we try to match the size of two squares which are not of the same size, the depth does not match. This is how farther objects look smaller.



DANCING GEARS

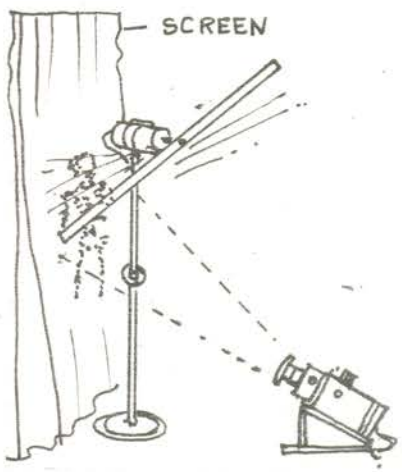


DANCING GEARS

Rotate the handle and see through the slotted disc. You see something like a gear movement. See through the upper portion of the wheel (or the bottom portion) -- no such thing happens or we see a fast moving picture of a wheel. The picture on the wheel is reflected from the mirror and a portion of it enters through the slot and stays for 1/16th of a second in our eyes. The next portion also enters and so on and it gives the feeling of a continuous gear movement. This is one of the predecessors of cinematography.

PERSISTENCE OF VISION

Any image persists on the retina of our eyes for about 1/16th of a second. Therefore fast moving objects look continuous toour eyes. This is why we cannot see individual blades of a rotating fan or rotating wheels of a bicycle appear to have no spokes. The fast rotating fan blades can act as a screen when light is projected on them. Here a rotating stick acts as a screen in which a skeleton picture is projected and we can see the complete picture.



PERSISTENCE VISION

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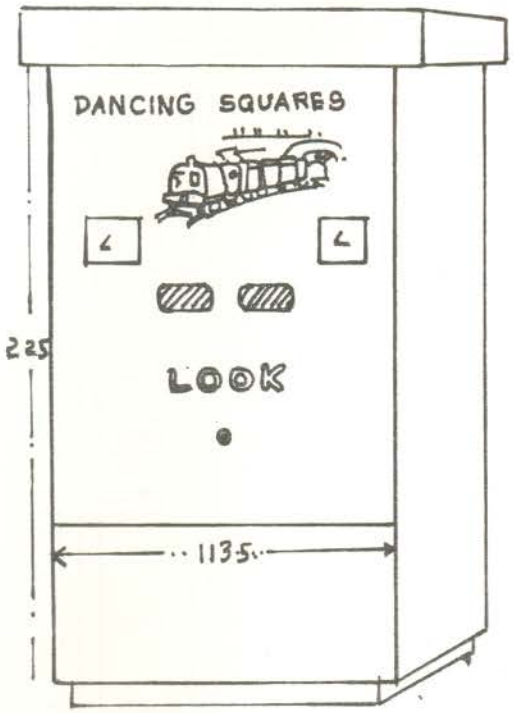
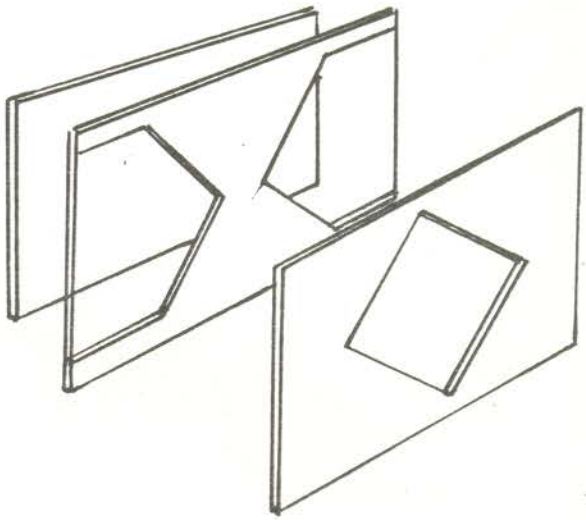
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
28	SIGHT	DANCING GEARS
ALL DIMENSIONS IN C.M.		



INNER MECHANISM OF DANCING SQUARES



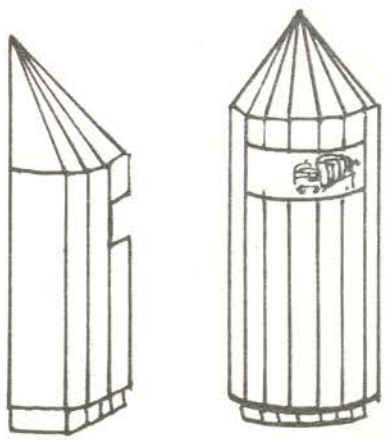
DANCING SQUARES

Press the switch and watch the approaching and receding squares. When the movement stops both the squares are seen at the same distance from you.

Our eyes and brain associate with the distance from daily experience. Approaching or receding objects of the same size are identified by their visible sizes. Even though sizes are same, approaching object looks bigger than the receding one.

Here the changing sizes of the squares give us the similar feeling of their movement towards or away from us. In fact they seem to be dancing.

HOLOGRAM

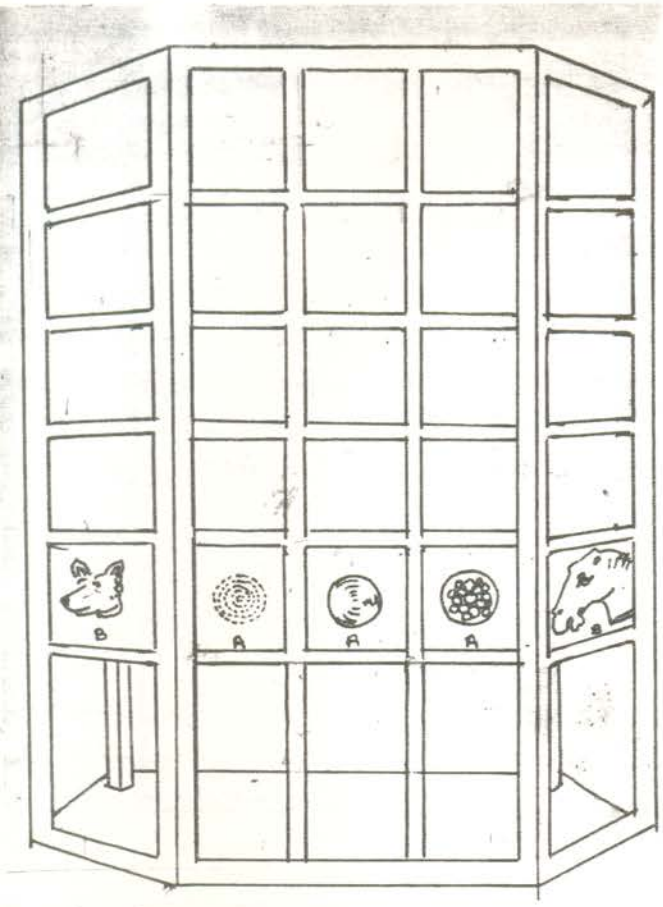


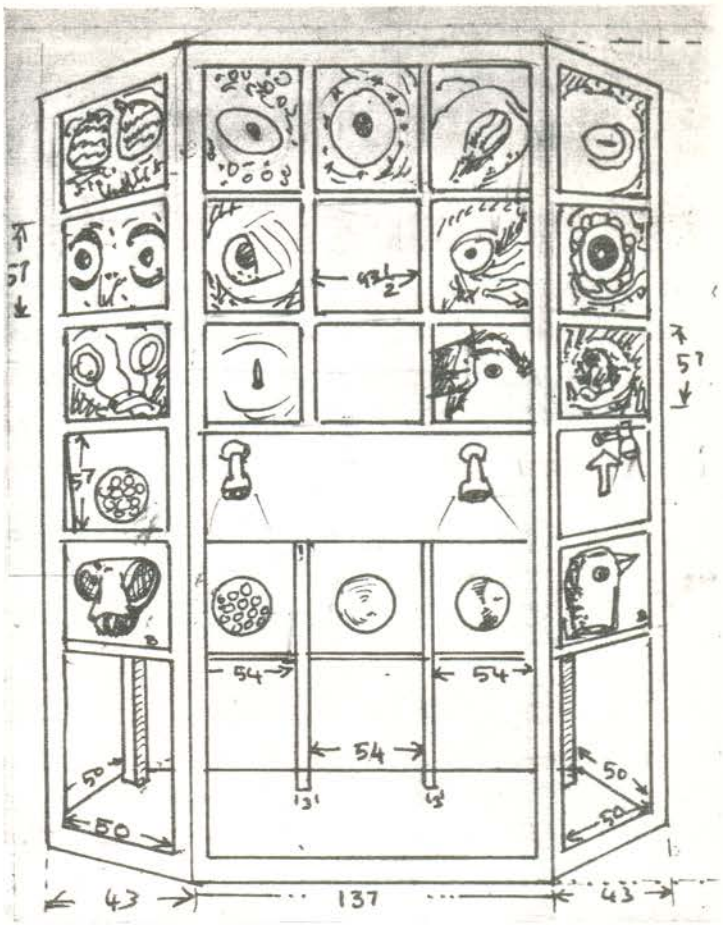
NEHRU SCIENCE CENTRE
BOMBAY. N.C.S.M.

LIGHT & SIGHT

SL.NO	SECTION	TITLE
29		Dancing Squares

ALL DIMENSIONS IN C.M.





WORLD OF EYES (TRANSPARENCIES)

1 NURSE SHARK
2 EAGLE
3 BLACK TIPPED SHARK
4 FEMALE HOUSEFLY
5 OWL
6 HARIN WORM
7 OCTOPUS
8 IGUANA
9 KING PENGUIN
10 TRIMERESURES GRANMERY SNAKE
11 ORANGOUTANG
12 GIANT GECKO
13 TARSIER
14 WRESSE FISH
15 CATFISH
16 SOUTHERN STARGAZER FISH
17 ASIAN CELESTIAL GOLDFISH
18 SQUID
19 GUITAR FISH
20 DOUBLE CRESTED CORMORANT
21 DESERT COCUST
22 KING VULTURE
23 ARIEL TOUCAL
24 HUMAN EYE
25 HUMAN EYE (EXPANDED)
26 TOAD
27 LITTLE SKATE
28 ANACONDA SNAKE

A) FRESNEL LENSES

B) ANIMAL MASKS IN FIBREGLASS

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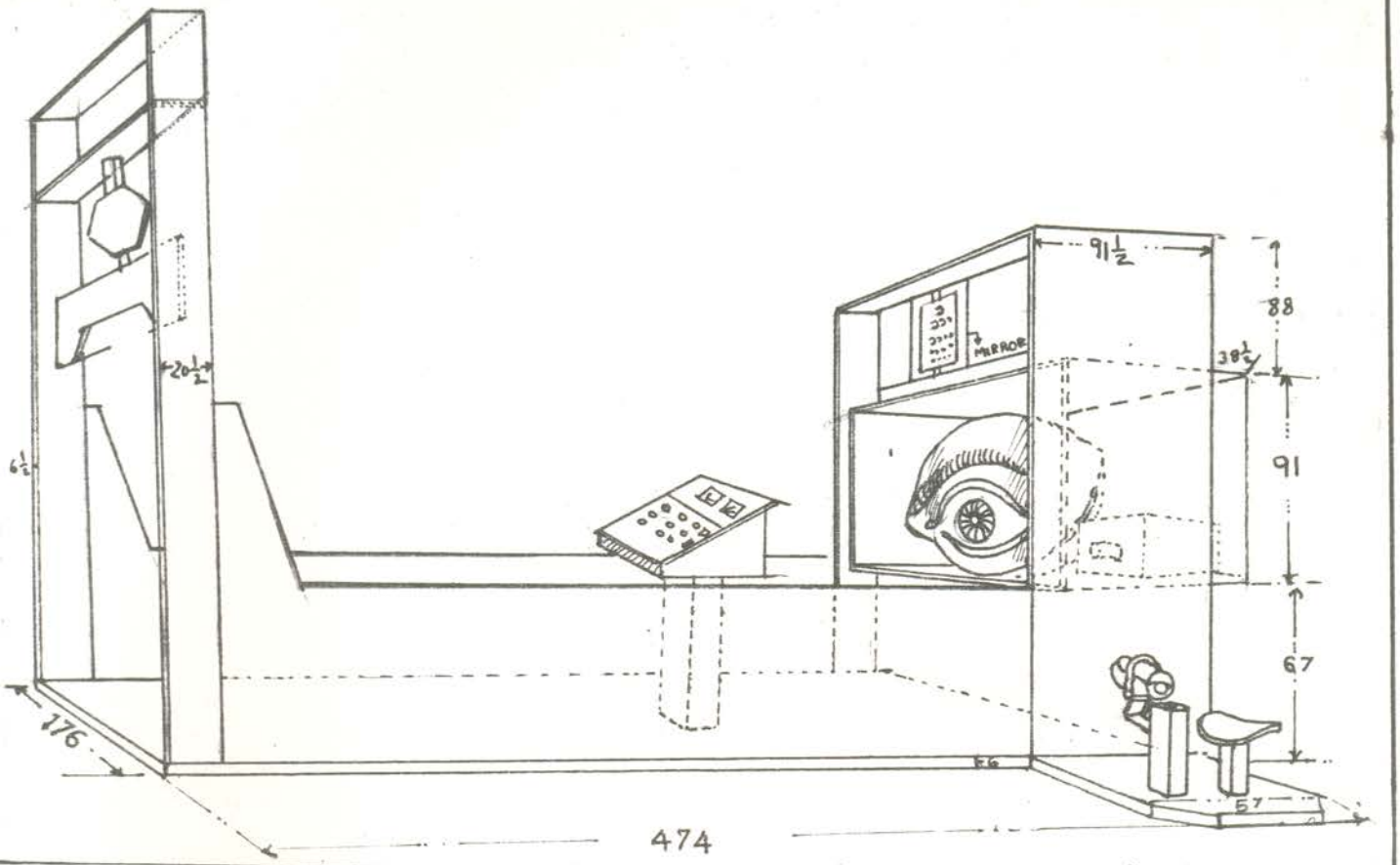
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
30		
ALL DIMENSIONS IN C.M.		

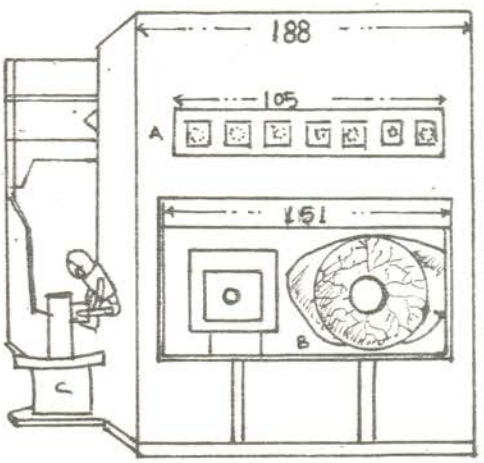


CHECK YOUR EYESIGHT

Press the START switch. Look forward at the lighted open circle in the mirror. Match the pattern to one on the keyboard and press the switch.

If you are correct the next line glows up. Match the patterns from left to right to the ones on the keyboard and press those switches in succession. Go on like this and see how far you read them correct.

If you are at fault at any stage, the buzzer indicates and your rating for distant vision lights up below.



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BOMBAY. N.C.S.M.

LIGHT & SIGHT

SL.NO	SECTION	TITLE
31	WORLD OF EYES	CHECK YOUR EYESIGHT

ALL DIMENSIONS IN C.M.

(A) COLOUR BLINDNESS

Stand in front of the inscribed numbers. Do not take more than three seconds to read any. If you read them as 12, 29, 74, 97, 7, no number and 26 (from left to right), you are not colour blind.

(B) EYE AND CAMERA

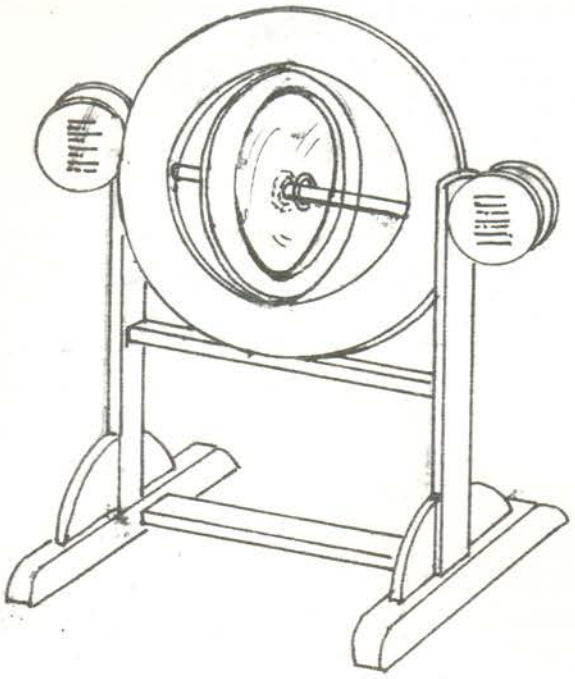
Our eyes are most delicate and sophisticated cameras with facilities for automatic focusing Inverted images are focussed on our retina in the same way as in a camera but the eye has far greater adaptability.

The eye has an automatic aperture control system like in most sophisticated cameras. The iris closes automatically in bright light to cut down the excess amount of light entering the eye and expands considerably at night to permit more light for clear vision.

(C) SEE YOUR PUPIL

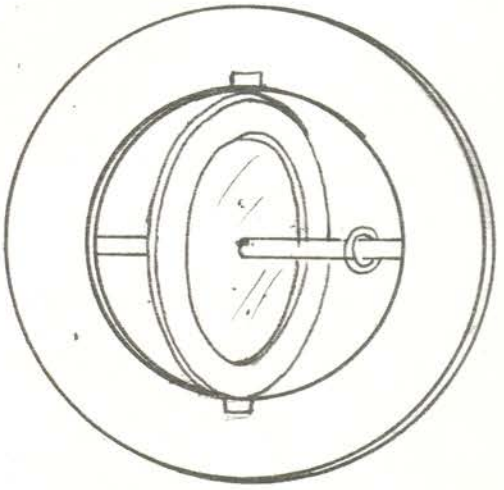
Look at your pupil by peeping into the mirror and note the size under dim light. Increase the intensity of light by the switch on the left and note the size of the pupil. The size in the latter case is obviously small.

The response of pupil to the intensity of light is a voluntary reflex. Light entering into our eye is controlled by the pupil. In dim light, the pupil has to open wide to gather all available light.

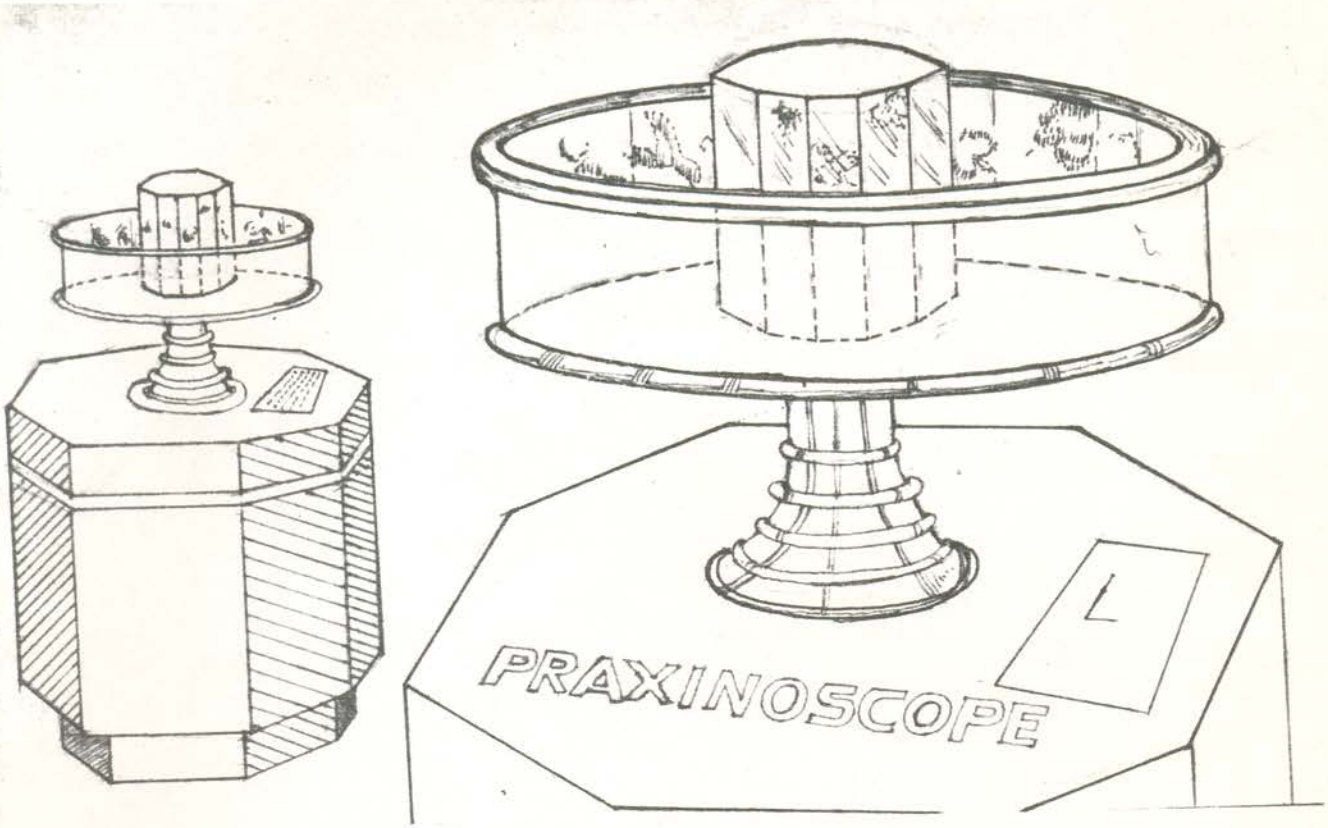


HAND-BRAIN CO-ORDINATION

Stand directly in front of the circular exhibit. Hold the rings with thumb and forefinger of each hand. Lean through the 'Mirror Window' at your right hand. The strange sensation that you get is the consequence of importance of hand eye co-ordination or feedback.



NEHRU SCIENCE CENTRE BOMBAY. N.C.S.M.		
LIGHT & SIGHT		
SL.NO	SECTION	TITLE
32	WORLD OF EYES	
ALL DIMENSIONS IN C.M.		



PRAXINOSCOPE

Rotate the wheel and look at the mirrors. The girl seems to blow soap bubbles. Quick superimposition of different postures of the girl & bubble caused by the rotation of the wheel produces this illusion.

The device, named praxinoscope, is an ancestor to the present-day cinema.

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LIGHT & SIGHT		
SL.NO	SECTION	TITLE
33		PRAXINO-SCOPE
ALL DIMENSIONS IN C.M.		