No 1

Optics

1. If light be material, will it not accumulate in, and at length fill up the eye? — Also what becomes of the light in a room after the windows are shut? — would not the magnitude of the Earth and other planets continually increase?

2. Is the velocity of reflected ~~light~~ the same as direct light? should it not be less? If so what change will this make in the appearance of the heavenly bodies? —

3. Why does a telescope not magnify when the focal distances of the object and eye glasses are the same?

4. Why does a telescope diminish the object when reversed? —

— Is this diminution in proportion

to

to the magnifying power of the telescope?

5. If one object be seen from another is it possible that the latter may not be seen from the former?

6. In estimating the quantity of light we always rate it much quantity more than it ought to be when compared to a greater quantity — A room has three windows open, when the sun is shining a certain quantity of light is admitted, when the second is opened the light is the room does not appear double much less trouble than all three are open; this owing to the

contraction and dilatation of the pupil —

7. All the primitive colours may be produced from three Red Yellow Blue — If deep they make a black

8. May not light be a quality a vibration through a subtle medium like sound. If so what is the medium? —

9. Does not light require some solid resisting body to render it perceivable?

10. What is the least visual angle

X If one minute the image on the retina will be the $\frac{1}{3000}$ part of an inch —

11. At particular times distant objects appear more elevated and more distinct

is not this owing to a greater refrac-
tive power in the air? Does that in
this mean of refracting power owing
to — Water — Heat — Cold —

12. The red yellow and blue cannot
be produced by the composi-
X tion of any other — From these
three all the others may be pro-
duced —

13. What is the best method of finding
the distinct focus of a Concave
XX glass?

14. With any two colours of the
prism not adjacent produce a
white? What is the best method
of proving this?

15. In shewing an Achromatic
telescope observe whether the
X lines which compose the object
glass touch each other, if they

do not but leave thin spaces of
brass to touch them a spunder the
telescope is not good —

16. The undulations of the air can
X not through a refracting Newt
a reflecting telescope — Does
(do the undulations arise from
the motion of the air within the
telescope? No — from the springs of the g'll.

17 When the magnifying power
is the same the Johnsons eye
X is observed 72" sooner by the
Achromatic than by the Reflecting
telescope according to Dr. Herschel
helyn, but others Astron? have
not found the same results —

18. If the magnifying power of a
reflecting telescope is in proper-
tion to the focus of the object and

and eye Glass the greatest variety from the division of the latter by how the power at what distance must the eye be placed from the Eye Glass to determine its field?

19. Mr B. Martin demonstrated that the telescope which Mr Short said magnified 200 times, magnified only 120, this vexed Short much, and it is said that he invented this to Astron. occasioned his death

20. The Achromatic Glass does not produce a distinct image in the focus. Does not make a good camera Obscura, if this be true what is the reason?

21 Dollond got the first hint of the Achromatic Glass from a man who wore spt with a concave and Convex Glass — This denied by Dollond

22. When the apperture of the object glass of Doctor Long field transit Telescope is contracted the object appears more distinct tho' not so much enlightened, the effect of the medium seems also somewhat lessened ——

23 A small degree either of convexity or concavity in an object glass at a distance is best discovered by the light falling obliquely on it ——

24. The nearest test of the goodness of an Achromatic Telescope is the following. Cut a circular piece of paper of the size of the object glass of the telescope, make a circular hole of about an inch in Diam. in the center of the paper

Adjust the telescope thus prepared
for an object about 20 yards distance
then remove the paste board and cover
the spot in the middle uncovering
the rest of the glass, if the object
with the same adjustment of the
telescope appear now distinct the
telescope is good there is no aberra-
tion of sphericity. ———

25 A Gentleman for a month or
six weeks has seen objects double
without having received any in-
jury in either eye or knowing
any cause. there is a small de-
gree of squint perceptible –
This case is similar to one
related by Doctor Darwin in
the philosophical transactions

26 May not the undulatory mo-
tion observed in a reflecting telescope
be ~~owing to~~ occasioned by the
× little irregularities of surface on the
speculum magnifying the motion
of the air? no– springs behind the speculum
(which I put go)

27 The Aqueous humour in young
Eye eyes is in greater quantity than
in old eyes– The decrease of the quan-
tity occasions the eye to get flatter

28 What the aqueous humour
Eye is let out of the eye, Nature soon
replaces it quere does she ever replace
the Cornea?

29 No muscular fibres have been
observed in the iris either circular
or Longitudinal, how then does it
contract owing probably to the distension
of the blood vessels – when filled they
become more straight – Circular
muscles

muscles or Sphincters have no share in the contraction of a cats eye

30. Some think that the reason why we see objects erect is the direction
Eye of the impulse – a stroke on the head would not come from the feet.

31. The Cornea ~~cont~~ collects a greater number of rays on the pupil.

32. It is affirmed that a refracting telescope generally shows a greater
no undulation in the air than a reflector, that certain states of the atmosphere answer best for the one, and others for the other

33. The insertion of the Corpus Ciliare is not in a line bisecting the Chrystalline lens, but more forward –

34. There is a fine ~~space~~ clear between the capsula and the Chrystalline lens in which the latter moves freely, there must be fibres to connect the capsula and humours – supposing by slender in the light is not obstructed and the ~~Chrystalline~~ lens falls out when the capsule is opened –

35. There are people in Africa who are almost blind ~~thro'~~ the day, but see well at night – Patients in this way have been found in England –

36. The Hemeralopia and Nyctalopia are often found – These diseases may be owing to the want of a power of contraction of the pupil and partly to the quantity of the pigmentum nigrum!

37. There is an Artery which runs through the Retina from the Optic Nerve to the Capsula of the Crystalline —

38 The momentum of the red rays is greater than that of any other, but the velocity is the same Therefore the quantity of matter must be greater — Hence there is no colour which fatigues the eye so much as red — Our Sensations to be agreeable must be moderate — Intermediate colours more agreeable, hence nature has made the Sky Blue and the earth green — Hence in certain diseases every object has a red tint —

39. In the Jaundice every object is said to appear yellow, this does not happen as frequently as is supposed — In old persons the Crystalline humour is a little yellowish

40 The pupil or Iris Nigrum and every part of a Negro is of a deeper coal Black than white People

41. It is observed that a torch must move round in one second to make a complete circle of fire —

42. A Person nigh sighted upon having the Crystl. Lens extracted or depressed becomes long sighted, and now requires a convex instead of a concave Lens

43. Why do we not see two objects with two eyes? Some think that we never look ~~at~~ with both at ones Eye to the object quickly from one to the other — Experiment of the finger held before an object with one eye it has a certain position with the other it has a different, with both it retains the last position — Does how long it retain this position?

44 A chicken the moment it leaves the shell runs to its food and ~~the~~ ~~will~~ makes no mistake with regard to the position of the object. Is not this an objection to the opinion of those who believe that all animals at first see objects inverted and mistake the Distance at which the object is placed

45. An object moved on the retina appears erect from habit — from our position with respect to the earth.

46. It is said that the mind cannot attend to more than one object at a time, does it not produce a variety of motions in the body at the same time? —

47. If a small hole is made in a card, and a pin passed slowly over it the pin is magnified and appears to move in the contrary direction — If the pin be moved near the hole on the opposite side of the card the pin is magnified but not inverted or in the former experiment —

48. If a concave ~~Glass~~ mirror is ~~held~~ placed before a large fire it will become heated but reflects no heat, only light; but if a metal specu-lum is used, it reflects heat and the mirror is not heated

— The same —

49 What is the smallest angle that the best Microm.r hitherto constructed can measure?

50 Is the light arising from the [illegible] fan air given Electrical or is it in flam.e air from the oils —

51 Telescopes tho' drawn out to the proper focal distance for the eye will seldom shew objects distinct except in one situation of the tube Hence long telescopes have generally the tubes marked

52. To find the center of a Double convex lens hold it in such a position as that the point of any object may be reflected from the same point of both sides of the lens or glass the spots may coincide —

53. The unassisted eye can see distinctly the 200 part of an inch

54. The magnifying power of the Solar Microscope is = to the Distance of the Screen divided by the focal dist. of the magnifier —

55. The Rays of Light add to the solidity of bodies — Philosoph.l Trans: 1786 —

56 The difference of length between a telescope with a convex and concave eye glass is three times the focus of the eye glass —

57. A Telescope with great brightness and small magnifying power has this advantage. it does not magnify the Medium —

58. Since the drops of water which form the rainbow are in motion why is the bow steady, why does it not sometimes change its place?

59. The air is probably of a blue colour —

60. Doctor Herschell's improvement of the Telescope will only apply to long telescopes. In short ones the object would be somewhat distorted.

61. The brass work for Achromatic Telescopes is all finished with the tool in the Lathe — no polishing

62. To find the breadth of the plane speculum in the Newtonian Telescope

As the Focal Dist: Great Mirror is to its Diam. so is Semi: D. of the great mirror to the breadth of plane Speculum

Ex in Doctr Herschell's T

40 ft : 4 ft :: 2 ft. 2. 4 Inches —

63. The field of a Microscope may be ascertained mechanically by making a mark on the table on each side of the apparent field

64. Doctor Herschell's Telescope and Apparatus weighs 16 Tons. The speculum half a Ton now 1 Ton

65. The magnifying power of Tel. is overrated by Instrument Makers — a power rated at 200 frequently does not exceed 150 —

66. Between sliding tubes with rings of superfine cloth much preferable to the common construction of refracting telescopes

67. Covers for the object glasses of telescopes ~~one~~ may be dispensed with when cases are used for the telescope — leather covers the best — Shagreen spoils the pockets of handkerchief —

68. Iceland spar has a double refraction, it has also a kind of focus, for the rays come together and cross each other —

69. The dispersive power of glass is increased by uniting Calx of lead with the Alkali. The Minium has no affinity to the flint but thro' the medium of the Alkali, even with this it is imperfect, and as the lead is heavier than the other ingredients it necessarily falls towards ~~the~~ the bottom of the pot. Hence the middle of the pot is always the best. the upper part has too little and the under too much dispersing power —

70 Flint glass is the most imperfect for optical purposes on account of the veins or threads which it contains these are occasioned by the lead falling to the bottom of the pot. If this be true should not these threads be more dense than

4 the other parts of the glass. This
is proved to be the case from the
rays being converged to a focus
or luminous line by the threads
— query what is the best method
of preventing this —

71. Glass for different purposes is cast
in moulds and allowed to cool in
the mould. It is generally without
threads. This method will not
answer for optical purposes, be-
cause here there is a kind of Crys-
tization which totally alters the
refractive power —

— Frequent pressure makes the
glass worse — covering the pot
imperfect —

To
The remedy the fore mentioned 72
imperfection of flint glass either
a new substance instead of Lead
or a more powerful flux instead
of the Alkali must be introduced

73. If the diameter of the large spe-
culum in inches be multiplied
by 60 it gives the highest magni-
fying power introduced by Watson
into his Reflecting telescopes

74. If pieces of red yellow and blue
silk are laid over each other
in the way of slate on the opti-
cal lens they may be so propor-
tioned (by Scott) as to produce a perfect white

75. The right eye is frequently better than the left — Experiment of the quill and candle —

76. When squinting is owing to the defect of the Cornea of Retina in the eye, would not a pair of Spectacles with Lenses fitted to each eye cure the deformity?

77. If the squint eye be of a shorter focal distance than the other will not the oblique position be accompanied from this, that the eye by turning to one side endeavours to find a ~~focal distance~~ line from the Object in order to bring the focus to the retina — If this be the case should not all right sighted people squint

78. Do not the Phenomena of a pinhole thro' a small hole corroborate some of the received principles of Optics?

79. In what manner does a person assist the refraction in looking thro' Crystalline Lens? Whether does the aqueous or Vitreous humour supply its place? is a lens used? — It is —

80. Baron de Tott mentions a Dr. Pellis who on one of the Pyramids of Egypt at three miles distance ~~at~~ appeared to man that he thought he could almost touch it, at one hundred paces it seemed much depressed, and magnified on a nearer approach. At 600 paces it appeared the biggest. At this distance the perpendicular height filled the visual angle. At a nearer

approach this angle embraces only part of the object, and at the distance of 100 feet it took in but $\frac{1}{3}$ of the object. Hence every object which exceeds the chord of the visual rays appear greater, and that which does not fill them appears less than it really is — This principle might be applied to publick buildings were the best point of sight to regulate their proportion. The Colonade of the Louvre has apparently enlarged in size since the pulling down of the houses which forced us to view it too near

81. What is the best method of determining the parallelism of the planes of glass & it is and that this can be done to the $\frac{1}{6000}$ part

of an inch. Common method is by floating the glass on Mercury

82. Sir Isaac Newton discovered that inflamable substances impede the rays of light much more than other substances — Hence he suspected the Diamond from its great refractive power to be inflammable which has justified his suspicions —

83. A Telescope is more steady when supported at both ends — Dr Hamilton first introduced this made of a portable stand for telescopes — Take one end in the waistcoat or breeches pocket makes a good support for a telescope

84. The great brightness of the reflecting Telescope allows it to bear an eye glass of a much shorter focal distance hence its great magnifying power

85. With a convex Lens of about an inch focus look at a Silver seal with a cypher engraved on it, it will at first appear engraved, after some time it will appear in Relief, again engraved and so on alternately. If you look of the seal for a few moments, when you view it again instead of being as at first, engraved it will appear in relief — By changing the light from the right where it appears engraved, to the left it appears in relief — When you suddenly incline the seal ~~move~~ the ~~light and~~ those parts that seemed to be engraved will appear in relief, and if while looking at it in this direction, you turn your self so that the light may fall on the right hand, you will see the

shadows on the same side from whence the light comes — The same effects will not be produced from a piece of money — Difficult —

86 Lenses of 6 to 12 feet focus [illegible] the best for Sculpture balls and baskets — No

87. If the rays of the Sun in the window fall on a concave (Plane) mirror and a piece of plane glass with small objects black on it be held a little beyond the focus of the mirror in the incident rays, a very large and bright image of the object will be formed on the opposite. — Pleasing Exper

88. The paper screen for the St. Ball and socket should be concave otherwise the ~~focus~~ image will be distinct only on one point —

89. In the experiment of the three
Ev objects on the wall viewed with one
X eye, if they be placed at a proper
distance, any two of them may be
seen but never all with one eye
90. To exhibit the spots on the Sun
Ball by the B. and Socket — The focus
X of the Lens should lie about 12 feet
if less the sun will appear too much
of much larger, he will not be sufficiently luminous ——

91. If the figures in the magic Lanthorn
be thrown on smoke as that of
incense they will appear curable and
as if they might be touched. It is ex-
tremely remarkable that tho' the
smoke moves, the figures are perfectly
steady —

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Optics — 16 June

92. To produce the appearance of a
Phantom by the magic Lanthorn —
— Place in a box a small magic
Lanthorn with a plane mirror
∠ 45° in order to throw the image
perpendicular to the horizon on
the top plane a chaffing dish or
which throws incense, then draw with
the slider with the images, they will
appear to rise upon the smoke
— N. B. A long Lanthorn will throw
them much better ——

93. Kings of Troy represented on the
Magic Lanthorn — 17 —

94. When a luminous object is viewed
in a plane mirror obliquely a round

of image is formed one from the
upper surface faint one from the
lower surface bright and towards
the thickness by reflections between the two
surfaces — eighth or tenth scarce vi-
sible —

95. Every plane mirror will reflect the
image of an object of twice its length
and twice its breadth —

96. In every concave mirror the image
formed in the center of concavity is of
the same size with the object —

97. In a convex mirror the image appears
seen behind the mirror and has the
same position as the object — Dimin-
ishes convex but not like
the mirror spherical — formed at
half the distance from the center
behind the mirror —

98. In concave mirrors converging
rays always form an image before
the mirror — In diverging rays if
the object be placed at less than
one half the distance from the mirror
the image will be behind the mirror
erect convex and magnified; but if
the distance of the object be greater than
the image will be before the mirror
inverted and diminished —

99. The following extraordinary decep-
tion may be exhibited
with a small bottle of water and
a concave mirror — Let the bottle
be a pint decanter of clear glass
fill it about 3/4 with water place
it a little beyond the focus of a
concave mirror so that it may
appear inverted the water does not
appear inverted but appears to

in the lower part of the glass
and leaves a part near the bottom
empty. If the bottle be inverted
the water appears to fill the
body of the glass and leave the
neck empty — If in this position
the water is allowed to run out
slowly thro' the cock, it will ap-
pear that while the neck part is
emptying the body of the bottle
is very remarkable upon the
bottle is empty the illumon ceases
the image also appearing entirely
empty — If while the bottle is
inverted drops of water fall they
appear like bubbles of air some-
at the bottom of the body of
the bottle and rise through the
water — cause of effect — contrac-
tion —

91 — 7

100 If two long concave mirrors be
placed parallel to each other at any
distance if a small quantity of gun-
× powder be placed in the focus of
one and a live coal be placed in
the focus of the other if the coal
be taken the powder will be
fired — Distance 12. or 16 feet —
mirrors of wood or paste board
gilded will produce the effect

91 — 8

101 The real spherical concave mir-
ror and flower — flower pot —
— moon &c —

102 The small mirror of a Reflecting
telescope may be made convex
× for then can the small mirror must
be placed nearer to the eye than the
focus of the great mirror — Telescope
shorter — Caseygrain's telescope —

103. A Gregorian Telescope may be converted into a Newtonian by substituting a small plane mirror in place of the ~~concave~~ Concave mirror ×
Through this the object will be more ~~less~~ bright, as the dispersion of the rays occasioned by the small mirror is diminished — but it magnifies ~~more~~ less — La L —

104 Tel. × The ~~The~~ magnifying power of the Newtonian telescope = $\frac{F.O.M.}{F.O.Ey G.}$

105. Tel. The Magnifying power of a Gregorian Telescope with one Eye lens is = $\frac{F.G.M.^2}{F.L.M. \times F.E.Glass}$ — La L —

106 Tel: × ~~Two~~ Lenses are commonly placed in the eye tube of the Gregorian Telescope in order to enlarge the field of view

The one next the object is large & of a longer focus than the other it receives the rays from the small mirror a little before the image in the second focus, they are contracted into smaller space and taken up by the second eye glass. The first is generally a plano convex or meniscus by which the rays refracted from the plane or convex side plane next the eye come less oblique to the other lens.

107. × In the Astronomical Telescope, two Eye glasses are preferable to one — field is enlarged — for a Telescope of 12 feet one lens of 3 and the other of 1½ inches — When a very high magnifying P. is wanted two glasses must be used in the eye tube, that next the eye must have a very small diameter to keep the eye exactly in the axis

107 The French writers use the word Telescope to express a reflector and Lunette a refractor

108 Gold Silver and Copper leaf held between the eye and the rays × of the sun, and viewed with a high magnifier exhibit fine appearances

109. The Sun's rays were thrown exactly condensed on a very light lever moveable horizontally motion was produced this was supposed to prove × the momentum of the rays. By Mr. Nicholl — Mr Brindley's opinion — might not the motion arise from the current of air occasioned by the heat excited in the lever? Try levers with them exhaustion and differently inclined to the horizon.

110. Sun's par. rays paint a distinct × image only in the focus of a lens, how does it happen that an object is seen distinctly with two different Lenses of different focal distances?

111. Why do the rays of the sun through an angular hole, project a circle at a certain distance? —

112. From some experiments of Mr. Hook and Mr. Romer in 1794. it appeared that the eye's adjustment to produce distinct vision at different distances depends on three causes, an increase of convexity in the Cornea, an elongation of the optic axis and a motion of the Chrystalline Lens. —

Optics

1. Ray of Light — Def.
2. Medium — air water Glass Diamond &c
3. Inflection — in the same medium —
4. Refraction — out of one Medium into another
5. Reflection — in the same medium
6. Angle of incidence —
7. Refracted angle —
8. Angle of Refraction
9. Angle of Reflection
10. Diverging rays
11. Converging rays
12. Parallel
13. Radiant
14. Foci
15. Conv. rays beyond Fo: become Div. and Fictitious
16. Imaginary Rad. or Virtual Focus —
17. Imaginary focus
18. Lens, its axes and Poles —
19. Div. Pt. in a Lens from a curve the base the Lens and the Apex the Radiant —

22. Axis of a beam of light

23. Rays direct, oblique on a lens —

24. Rad.t rays refracted by a lens form a cone of which the ~~base~~ lens is the ~~base~~ base and the ~~apex~~ ~~the~~ focus the apex —

25. Pencil of rays, incident rays and refracted cone taken together —

26. Sines of small angles are nearly proportional to the angles themselves

27. Divergency of rays measured expressed by the angle contained between the ~~rays~~ lines which the rays describe —

28. If the distance of diverging rays which issue from different Rad.t be the same, then the distances of the Rad.t are inversely as the angles of divergency — (or the vertical angle is inversely proportional to the distance —

29. In converging rays, the same proportion applies to the foci —

30. } Rad.t and Fo. at an infinite distance the
31. } rays are parallel

32. The sides of plane triangles are to one another as the sines of their opposite L s

33. The progress of light not instantaneous — proved by eclipses of Jupiter's Sat.s — moves 10 Millions times faster yr a cannon bullet

34. Light in straight lines — represented by straight lines

35. Light is a body — rays successive in the same line — contemporary in different lines

36. Rays exceeding small — Momentum $\frac{1}{200}$ part of a grain would have the same momentum as a cannon ball — pin hole in a card — Candle — The wonder ceases when it is considered that matter is infinitely divisible —

37. If a ray passes out of a rarer into a denser medium it will be refracted to: wards the perpendicular — attraction —

– in proportion to the density – ray accelerated
near the surface of the denser medium –
Composition and resolution of forces – a
gonet longer than a side – Proved
also by experiment – Vessel empty
shadow, then filled with water –

38. From a denser into a rarer medium
refracted from the perpend. – proved
by the compos. and resolut. of forces –
Exp. of the bason and Shilling –

39. All refraction is reciprocal i.e. if the
refracted ray becomes the incident, then
the incident will become the refracted

40 Where the mediums are the same
the sine of the incident bears always
the same proportion to the refracted
angle

41. Perpendicular rays suffer no re-
fraction –

42. Parallel incident rays produce
parallel refracted rays when they
enter a plane surface

43. The divergency and convergency
of rays will be lessened when they
pass out of a rarer ~~medium~~ into a
denser medium, through a plane sur-
face

44. – But increased when out of a
denser into a rarer medium –

45. When diverging rays are refracted
at a plane surface, the distance of
the real Radiant is to the dist: of the
Imaginary Rad: from that surface
as the sine ~~of~~ ~~[illegible]~~ of the Refract
∠ to that of incidence

46. – Converging ray – Imaginary Focus
to the real : S, Ref: ∠ : S. ∠ Inciden

47. Rays passing through a plane
Glass Refraction and Incident Directions
with respect to each other the Same

40. Parallel rays through a convex surface converge to the axis —

41. —— through a concave diverge

49. —— through a convex

50. Parallel rays through a convex surface the semidiameter of the sphere of which that surface is a segment is, the distance of the focus whether real or virtual, as the sine of incidence is to the sine of refraction.

51. Par. rays through a plano-convex focus = 1 Diam.r of the convexity —

52. Concave negative focus = 1 Diam.r

53. Double convex — the convexity on both sides equal focus = $\frac{1}{2}$ Diam.r in centre —

54 —— Double concavity — equal — negat. Fo. = $\frac{1}{2}$ Diam.r —

55. Par.l Rays on any convex lens as the plane of the semidiameter of both convexities : semidiam.r of either :: Double semid.r of the other : the focal Dist.

56 —— Concave — Neg.e focus — same proportion —

57. Rays thro' a convex lens do not all meet in one point —

58. — Concave — Rays not all diverge from the same negative or imaginary Radiant —

59. Beam falling obliquely on a lens the focal Dist. nearly the same as when it falls directly —

60. — Principal focus both real and negative is found by par.l rays —

61. Rays diverging from the Princip.l focus of a convex lens, — parallel

62 — Rays converging to the principal focus of a concave lens — parallel —

63. When Radiant is farther from a convex lens than the principal Fo. the rays after they are refracted will converge

64 — Radiant more remote than 2 Princ.l Focus of a convex lens — its Dist.e between the principal Fo. and Rad.t is to the principal focal distance as 20 is the distance of the Rad.t before refraction, to the focal dist. after Refract.n

65. If the imaginary focus of a concave lens is at a greater dist. than the ext. — the rays when passed through the lens will diverge —

66 Imag.ʸ Fo: more remote than the Prin.ˡ Fo — so is the Dissˡ is to the Prin.ˡ Fo — so is so is the imag: Fo. before reflection to the distance of the imaginary Radˢ after it —

67. If the Radˢ is nearer to a convex lens than the principal focus, the rays will continue to diverge, but no so much as on the other side —

68. — In the former case, As the Dissˡ: Rᵗ and Prin: Fo. is to the D. Fᵒ. so is the real Radˢ before reflection to the imaginary Radˢ after it —

69. If the Imag: Fo. to which rays converge is nearer to a concave lens than its Prin. Fo. — Rays will continue to converge less than before —

70 — In the former case As the Dissˡ Inˡ and Principˡ Fo, to the distance of the Prin: Fo. so is the Distˡ Inˡ Fᵒ. to the Distˡ Real Fo.

71. When a radiant is farther dist. than the focus — or the Radˢ a focal distance, the focus recedes from the lens on the other and Vice versa

72. — When farther, then both the real and imaginary radiants will approach or recede at the same time

73. If the real Radˢ is close to a convex lens, the imaginary one will also be close to it —

74 Converg. rays on a convex — converge more when through it

75 —— As the sum of the Prin.ˡ and Inˢ Foci: to the Distˡ Inˡ Focus so is the Distˡ of the Principal Focus, to the Distˡ real Focus

76. Diverging rays on a concave lens — will diverge more on the other side

77. When diverging rays pass through a convex lens, Sem. Diam.r Fo, and Rad. Rad.r is the Distance of the real Rad.r so is the Diam.r F to the Sem.r Radiant —

78. When Diverging Rays fall on a convex lens the Real and Sem.r Radiants move in the same way. —

79. If the Real Rad.r is close to a convex ~~lens~~ lens, the Sem.r also, ~~is~~ ~~the same~~ —

80. In a Meniscus, as the Diff between the Semidiam.rs of the two surfaces, to the Semidiam.r of either: so is double the Semidiam.r of ~~the~~ the other surface, to the principal focal Distance

81. Par.l Rays through a Sphere converge at half the Semid.r —

82. Par.l Rays through a Sphere of water converge at one Semidiameter —

83. Rays of light flowing from different points of an object will after passing through a convex lens converge to corresponding points nearer the object if at a greater distance from the object than its principal focus — and

84. An image of the object —

85. Picture or image inverted

86. Picture distinct only in the Focus

87. As the Object approaches the Lens the picture departs and V.c V.a —

88. When the Object is parallel to the picture the Diam.rs are doubly as the Distances

89. When the picture is confused it is larger than when distinct —

90 Object and distinct picture are similar surfaces —

91 When the object is given the Diam.r of the Distinct picture is inversely as the Distance of the object from the lens —

92. Area of the picture is inversely as the square of the objects distance from the lens

93. When the dist. of the object is given the Diam. of the distinct picture is directly as the Diam. of the object

94. While the Diam. of the object remains proportional to its distance the Diam. of the distinct picture will always be the same

95. When the diameter and distance of the object are given, the diam. of the picture will be directly as its distance from the lens —

96. — area as the square of its dist. from the lens —

97. Though the dist. of the object from the lens should be varied yet the distinct picture may be preserved invariable i.e without varying its distance from the lens —

98. — Dist. of the object from the lens should be varied, yet the picture may be preserved distinct without either moving the paper or changing the lens —

99. When the object is very near the lens though its dist. be greater than its principal focal distance yet, in order to make the picture distinct, the area of the lens must be very small —

100. When the Dist. of object and picture and likewise the Diam. of the object are given, the Diam. of the picture will not be attained by altering the area of the lens

101. Brightness directly as the area of the lens — Distance from the lens being given

102. — Given area, and Dist. object, given brightness of the picture, is inversely as the Dist.^{2} from the lens —

103. Given area of the lens, brightness of the Object will be the same let the distance be what it may

104 Ceteris paribus the brighter the object the brighter the picture —

105. A very small hole will exhibit on an
outd picture without the lens
106 — Distance of the Object and picture
given, Diam. of the picture in propor-
tion to the Diam. of the hole —
107. Heat of the focus when the area is given
is as the square of the focal distance in-
versely —
108. — When the focal dist. is given the
heat is directly as the area —
109. — Heat of a burning Glass is to the heat
of the sun as the area of the focus to the
area Glass, inversely —
110. — The inverted picture on the
bottom of the eye —
111. Optic axis — of the Chrystalline —
112. Middle of the Retina, where the
optic axis meets it —
113. Pictures on the retina are the
cause of vision
114 — Point of an object to which the
Optic axes is directed is seen more
distinctly than the rest —
115. Objects erect when the pictures on
the retina are inverted —
116. Object single, tho' seen with both
eyes —
117. When the object is more remote y^n
the convergence of the Optic axes, it
appears double. — the left hand appearance
is seen by the left eye, and the right
hand by the right eye —
118. — Mem. — Double — left hand by
the right eye and right hand by the left
119. The Choroides the principal seat of
vision
120. To see objects distinctly at different
distances some change must be
made on the eye — Convexity — Distance. Chrystl.

121 — In some eyes only very near objects appear distinct — short sighted

122 — Long sighted

123 — Object may be either too near or too remote to be seen distinctly

124 — Optic angle

125 — Apparent Diam. :: D. object's position on the retina

126 — Diam. of an Object given, the apparent D. is inversely as its Distance from the eye

127 — Distance given — App. D. is directly as the real D.

128 — App. Ds of Diff. objects at Diff. Dist. from the eye will be equal when their real Ds :: Dist.

129 — App. D. of any object seen obliquely is :: app. Length of a perpendicular to the optic angle, perpendicular to the optic axis

130 — Equal objects seen very obliquely the apparent Lengths of them are inversely as the squares of their Dist. from the eye

Optics

131 — App. D. of an object not changed by contracting or dilating the pupil

132 — Celsus Barbus, an object will appear larger when seen confusedly than when seen distinctly

133 — Bright objects seem to be larger than obscure ones

134 — Objects would appear equally bright at all distances if no rays were intercepted in their passage from them to the eye

135 — Our Judgment of the Distance of an Object does not depend on any one principle

136 — In viewing objects that we are much used to, if they are at such distances as we can readily allow for, the judgment of the mind respecting their magnitude is commonly more attended to than the perception of the eye

of Repeated Vision through Single Convex

137. A small object a point of an object is seen after repeated Vision by the rays after their last Incidence

138. In Vision by Refr. it is not the object but the last image of the object we see — consult all the Inst. Radius

139 The Appt. place of a Star is higher when near the Horizon, than it is near the Zenith

140. The moon & Star is to the horizon the more the place is changed by the refractn of the Atmosphere

141. The Sun and full moon appear in a oval figure when in the horizon

142. A vessel seems to be shallower when full of water, than when it is empty —

143. In vision through any Glass the object & its last image are on the same side of the Glass; but inverted if they are on the contrary

144. In all Lenses the Diam.r of the Obj.t is to the D.r last Image as the Dist.e of the Obj.t from the Lens to the Dist.e of the Image from the Lens —

145. The object it self is the object of plain vision the last image is the object of repeated vision

146. Appt. Magn.e seen through a Lens is :: Appt. Mag.e last image

147. When the Lens touches either the object or the eye the appt. Mag.e not alter'd —

148. — Through a Convex Lens — Object seem to be less than it is D.r Fig. — brighter than to the Naked eye and exact and Distinct

149. — Farther, — will appear brighter but will be confused and not proper for the eye be nearer to the Lens y.n the Distinct picture —

150. — Object in the Principal focus of a Convex Lens — brighter — Distinct and erect —

151. — Convex Lens — Object nearer than Pr. Fo. it is magnified, unless the eye touches the Lens or the Lens touches the object, and as the eye departs from the Lens the appt. Magn: still decreases —

152. — Convex Lens — Object farther off than Pr. Focal Dist: and the eye on the other side is nearer than the picture the object appears magnified unless the eye touches the Lens, and the appt. Mag: will be inversely as the distance from the Distinct picture, so that as the eye withdraws from the Lens towards the picture, the appt. Mag: will encrease.

153. Convex Lens — Object in the Pr. Fo will be Mag: unless the eye touches the Lens, and the appt. Mag: will be altered by a change of Dist: in the eye —

154. — Convex Lens — When the eye and Object are fixed — Lens moving from the eye, magnifications is the nearest when nearest to the object — Provided the eye is never more remote from it than the place of the Distinct picture

155. Convex Lens — Eye in the prin: Fo. object departing from the Lens is not Mag: — Eye more remote, the appt. mag: increases, if less remote it decreases.

156. We commonly make a wrong judgment of an Objects appt Distance when we see it through a convex Lens erect

157. — Convex Lens — Object farther off than Pr. Fo. — eye on the other side than the Distinct picture, the place of the object of expected vision is at a greater Dist: from the Lens than the place where we look for it —

150 —— eye at a greater distance — object appears smaller than to the naked eye, moved, and may be seen distinctly

159 Object more remote from a lens — than the A.F. — eye more remote from the lens than the distance of the app. F. of the object is distinctly as the farthest distance from the lens, and indistinctly as its distance from the eye

160 —— In the former case, the field of the object of app. vision is more — than when we look for it —

161. —— If a lens be moved towards the right or left hand the object will appear to move in the same direction, but if the eye is moved, the object will appear to move in the contrary direction —

162. Concave lens — object seems erect and may be seen distinctly

163. Concave lens — App. Mag. is diminished, unless eye touches the lens or the lens the object, and as the eye departs from the lens the app. Mag. decreases

164 Concave lens — (reverse of 154)

165. Concave lens — App. Mag. decreases as the object departs from the lens

166. Wrong Judgment of an object seen through a concave lens —

167. Short sighted people see objects distinctly at a modest distance by the help of a concave lens —

168. Old people — convex lens

169 Objects seen through a Galileon Glass are erect — nearer. and seem brighter and larger than when they are seen by the naked eye —

Telescopes and Microscopes —

170. Astronomical Telescope described —

171. Very remote objects distinct and [illegible]

172. Appt. D. of an Ob. seen by the Astr. Telesc. is to the appt. D. by the naked eye at the Station of the Obj. Glass as the distance of the distinct vision from the object Glass is to its distance from the eye Glass — or as the focal

173. — will not magnify an object unless the princ. Focal Dist. of the object Glass be greater than that of the eye glass —

174. An object may be equally magnified by two Tel.s of very different lengths

175. Objects seen through an Astron. Telescope inverted, appear to the mind erect —

176. The field of view or visible area is proportional to the area of the eye G.

177. Brightness depends solely on the area of the object glass — but this does not affect the field of view —

178. — Distance of the eye should be = the eye glass's princ. F. Distance

179. Double Astronomical Telescope consists of 4 lenses —

180. — Object distinct and erect.

181. — Mag.n power in proport. of the d. F. of the Obj.e Glass to the d. F. of the first eye Glass. —

182. Galileo's Telescope consists of a convex object Glass and concave eye Glass placed at the Difference of their focal Distances —

183. — Object erect and distinct

184. — Mg.n Power :: d.e Focal Distances

185. — Area depends on the breadth of the prospect —

186. — In using this telescope, the eye should be close to the eye glass —

187. A single micro: consists of one convex lens —

188. A Double micro: consists of two convex lenses, of which the object glass is more convex than the ey: glass — Dist = Sum of their Foci —

189. — Object distinct and inverted

190. Appt. D: through the micro: is to the Appt. D: seen by the eye at the object glass, as the Distance of the Distinct picture from the object glass is to its Distance from the eye glass —

191. Object seen through a micros: appears larger in the proportion of the limits of Distinct vision to the Distance of the object glass from it

192. A microscope magnifies the Appt. D: of the object, in the Compound ratio of the Distance of the Distinct picture from the object glass, to its Dist: from the ey: glass; and of the limits of Distinct vision to the Distance of the object glass from the object —

193. When the same eye glass is used the Mag: p: is increased by increasing the convexity of object glass —

194 — Appurtenances of the object glass should be very small

195. — To short sighted persons a Telescope or Microscope should be a little shortened

196. Old persons require the Telescope and Micros: a little lengthened

Reflection
Cause and Laws of

197. The Reflection of light from transparent bodies is either partial or total. ~~the partial happens either~~ at the first or 2d Surface, the total at the 2d Surface only

198. The Rays are not reflected by striking against the solid parts of bodies

199. Bodies reflect and refract light by one and the same power differently exercised in different circumstances

200. In all cases the ~~complement of~~ angle of reflection is equal to the ~~angle~~ complement of incidence and the ∠ of Refl.n = ∠ Incid.

Refl.n from plane Mirrors —

201 The Cathetus of Incidence is the axis of any beam, or is a perpendicular drawn from any Rad.t to the plane of a ~~...~~ Mirror on which rays fall which come from the Rad.t

202 Parallel incident rays are paral. when reflected

203. If diverging rays are reflected from a plane mirror, the Dist. of the Im.g Rad.t behind the mirror is equal to the Dist. of the real one before it — Divergency of the Rays not altered by reflection

204. —— Converging rays — Focus — convergency not altered

205. —— Convex and concave Surfaces
Parallel rays falling on a concave Mir.r reflected — focus at half the semidiameter of the concavity —

206. —— Convex Mirror — ~~Divergent~~ ~~F~~ Diverge — Virtual or Negative Focus = ½ same D.r convexity

207. In a Concave Mirror par. rays do not all converge in the same point and in a Convex Mir.r do not all diverge from the same ~~radiant~~ ~~virtual~~ virtual focus —

208. Principal focal Dist. of a convex and concave Mirr

209 If the Rad.s is in the Prin.l Fo. of a concave mirror, the reflected rays will be par.l

210. If the Inc.t Focus of converging rays is in the Pr.l Fo. of a convex Mirror, the reflected rays will be parallel —

211. In a Concave Mr. if the Rad.s is more remote than the Pr.l Fo. the rays that from the Mirr diverge from it will converge after they are reflected

212. —— + As the Dist. of the Rad.s from the Mirror Surface is to its Dist. from the center of concavity; so is the distance of the focus from the surface to its Dist. from the center

213. If the Inc.t Focus is more remote from a convex Mirror than the Pr.l Fo. rays which converge to that magnus Focus at their Incidence will diverge after they are reflected —

214 —— + As the Dist. of the Inc.t Fo. from the Surface is to its Dist. from the center of Convexity, so is the Dist. of the Inc.t Rad.s from the Surface after reflection to its distance from the center

215. If a radiant is more remote from a concave mirror than its Principal focus, as the Rad.s approaches the focus it departs from the Mirr and v.v.

216. If the Rad.s be in the Center of the Mirror Concavity, the focus will be in the same point —

217. If the Rad.s be on one side the center of Concavity, the focus will be on the other side —

218. If the Rad.s is nearer to a concave mirror than its Pr.l Fo. the rays which diverge from there will continue to diverge, but less than at their Incidence

Optics

219. If the Rad.t be nearer to ~~the~~ a concave mirr than its P.t Fo. as the Dist. of the Real Rad.t from the Surface of the Mirr. is to its Dist: from the center of the concavity, so is the Dist: of the Imag. Radiant from the Surface after Reflection to its Dist: from the center —

220. If rays converge at their incidence upon a concave Mirror to an Imag.y Focus which is nearer than the P.t Fo. the Reflected rays will continue to converge, but less than at their incidence —

221. If rays converge at their Incid: to an Im.y P.t Fo. nearer to a convex Mr than its principal Focus, as the Dist: of the Im.y P.t Fo. from the Surface, is to its Dist: from the center of the ~~Mirr~~ Convexity so, after reflection, is the Dist: of the Real focus from the Surface to its Dist: from the center —

222. If the Rad.t is nearer to a Concave Mirr. than its P.t Fo. as the real rad: on one side approaches to the Mr. the Im.y Radiant: will approach on the other side and Vice Versa

223. If the real Rad.t is close to a concave Mirror, the imaginary will also be close to the mirr —

224. If rays converge towards a concave mirr they will converge more after reflection —

225. Concave Mr.— Converging rays reflected — as the Distance of the Imaginary Focus from the Surface is to its Dist: from the center of concavity, so is the Dist: of the real focus from the surface to its Dist: from the center —

226. Convex Mr. Diverging incident rays — more diverging after reflection —

Convex Mr: Diverging rays —

227. as the Dist: of the real Rad: from the Surface of the Mirr to its Dist: from the center so is the Dist: of the Im.y P.t Fo. from the Surface after reflection to its Dist. from the center —

228. If the inct Rad.s is close to a concave
mir. the Im.g Rad.s also —

Plane Mirror

229. Passage of reflection is the incident ray
added to the reflected ray

230. An object after being reflected is al-
ways seen in the direction of the last
reflected rays

231. In all mirrors whether plane or spherical
the place of the image radiant
when it can be determined is the
intersection of the Catheter of Incidence
and ~~the~~ any reflected ray —

232. In plane ~~mirrors~~ the distance of the
last image from the Mirror is equal to
the Dist: of the object from it, and
the Dist: of any point in the last
image from the eye is equal to the
passage of reflection

233. Plane Mr.: Image equal and Similar
to the object.

234. P. Mr. and Object both perpend.r to
the Horizon, object appears erect —

235. Obj.t Par.l to a P. M. the length of the
Image is to the length of the object
as any reflected ray is to the Passage
of Reflection

236. By bringing the eye nearer to, or re-
moving the object farther from the
Mr. more of the object will be seen

237. ~~Image~~ P. Mr. Area of the image surface
is to ~~the~~ the area of the object's as the
square of a reflected ray is to the square
of the passage of reflection —

238. If a person sees his whole body in
a plane Mr. which is par.l to him,
the glass will be ½ his length and
½ his breadth or ¼ his area —

239. In a P. Mr. Right hand side of the
object Left Hand image & V. V.

240. If a P.M. is perp.r to the Horizon Objects Perp.r to the horizon appear inverted —

241. P.M at 45°. Object par.l to the horizon will appear erect in the mirror and an erect Object will appear Parallel

242. An object placed between two plane Mirrors inclined to one another at any angle more than one image will be seen —

243. All the images that appear in two plane Mr.s inclined to each other are in the circumference of a circle the semidiameter of which is the Dist. of the object from the vertex of the angle contained between the Mirrors

244. When two plane mirrors are inclined to each other, the images of each set end, when ~~the~~ each Cathetus of incidence ends between the two Mrs continued

245. — Angular Dist. between the two first images is equal to double the ∠ inclination of the Mr.s —

246 — Angular Dist. between any two images of each set that are produced by the same number of reflections is greater than the angular Distance between the two preceding ones by double the angle of inclination —

247. ∠ Divide 360 by the ∠ Inclin.n gives the Number of images —

248. Two par.l plane Mr.s innumerable objects may be seen all in a straight line

249. In a single plane Mr. of thick Glass many images of a bright object may be seen —