



## **Philosophical Transactions**

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*An Account of some Books.*

- I. *Lectiones 18, Cantabrigiæ in Scholis publicis habitæ, in quibus OPTICORUM Phænomena Genuinæ rationes investigantur & exponuntur, ab Isaaco Barrow, Coll. S. Trin. Socio, Mathes. Profef. Lucafiano, & Soc. Regiæ Sodali. Londini, 1669. in 4°. Impensis Joh. Dunfmore ad Insigne Rosæ & Coronæ, in Cæmeterio D. Pauli.*

**A** Brief summary of these *Optick Lectures* the Excellent Author doth himself deliver in an Epistle to a Friend, who desired such an one from him; when he saith, that in them he endeavoureth to promote that part of *Opticks*, which he undertakes to treat upon, first by explaining and establishing its Principles; then by deriving from them some useful Confectaries, serving to the explication of the *Phænomena*: in the mean while attempting to correct some common errors, and to supply some principal defects therein.

Towards these purposes, he first examineth the received *Hypotheses* of this Science, shewing, how they should be understood, and how far admitted; assigning also some *Physical* causes of them, (in the performance whereof he declares himself not to confide much, but only requires the *Hypotheses* themselves, as not disagreeable to Reason, and very congruous to Experience, to be admitted.)

Having first settled the *Hypotheses*, he first draweth from them some general Corollaries, partly before acknowledged by others, and partly observed by himself; all confirmed by his own demonstrations.

Then proceeding to more Special matters, he prosecutes distinctly *Catoptricks* and *Dioptricks*, both *Plain* and *Spherical*. And slightly passing over *Plain Catoptricks* (as easy and commonly treated on, truly enough,) he more largely insists upon *Spherical Catoptricks*, propounding such Theorems, whereby the Intersections, and the Limits of Reflected rays are declared, and together the Appearing places, or images of points radiating both from a great (and, as it were, immense) distance, and from a distance sensibly near, are determined, both in respect of an eye placed in the Axis of the radiation, and in respect to one placed *without* that Axis any where; the which particulars

particulars he had not observed in any Book extant to be truly and diligently handled.

Then he from the foundation raiseth a *Theory* concerning both *Plain* and *Spherical Dioptricks*, assuming for a ground that rule concerning the Measure of Refractions, which Mr. *Des-Cartes* first discovered, and which now most of the best writers do admit, and which he judgeth agreeable to truth (for that all deductions from it very well suit to experience) which yet he knows not that any writers have applyed to this purpose, so as to have raised any competent superstructure thereon. And here orderly (first in respect to *Plain*, then to *Spherical Surfaces*,) considering points radiating from a distance so great that their rays may be supposed to fall parallel to one another upon the refracting surface, he propounds some *Theorems*, from which the chief Symptoms of refracted rays do result; their Interjections and Limits are easily discernable; the appearing places or images of such points are defined, both in regard to an eye situated in the Axis of the radiation, and in regard to one placed *elsewhere*. Then he prosecutes in like manner the same things in respect to *Points*, radiating from a distance sensibly finite or near.

And that the Use of these things may be more ready, and serviceable to practise, he subjoyneth distinctly and particularly the determinations of the places in the Axis of the Images of points however radiating through each kind of *lentes*.

Having dispatched these matters, he toucheth generally concerning the making a judgment about the Appearances of Magnitudes (as to their situation and figure,) which follow those sorts of reflection and refraction: Afterward more specially and copiously, he shews what kind of Images plain objects do yeild from such reflections, and how they may be delineated.

Among these things there are interspersed some considerations about divers incident matters, as about the nature of Light, and the causes of different Colours about the Rainbow, or colours appearing in pellucid globes; about some appearances in the vitreous *Prisme*; concerning the *linea refractaria*, concerning the resolution of problems by Appropriate lines; concerning the properties of the *Conical* sections in the reflection of lucid rays, &c.

II. *Lectioes* 13. *GEOMETRICÆ*, in quibus (præsertim) *Generalia LINEARUM CURVARUM Symptomata* declarantur ab eodem Iſaaco Barrow, &c. *Impenſis ejuſdem Bibliopole*, in 4<sup>o</sup>.

Concerning the *Geometrical Lectures*, arguing great depth in the Mathematical Learning,

In the *first* of them, in order to what follows afterward concerning the *Generation of Magnitudes*, the Deserving Author treateth about the Nature of *Time*, as it may be considered in Mathematical suppositions about such Generations.

In the *second* are declared the Mathematical *Hypotheses* about simple Motions (progressive and Circular,) which serve to the Production of Magnitudes, together with some general remarks, about the natures, dimensions, and properties (consequent on such productions) of Magnitudes. There is also a touch about the Method of *Indivisibles*, explicating, how in some cases it is to be understood and applied.

The *third* treats about the Generation of Magnitudes by composition and concurrence of motions.

In the *fourth* and *fifth*, from one generation propounded of Curve lines, (supposing them produced by two motions, one uniform, the other accelerated) divers Theorems are inferr'd, implying so many general properties of Curve lines.

The next *five* Lectures do contain many Theorems, and Problems about readily determining the *Tangents* of Curve Lines, immediatly by them, without other computation; particularly, there are divers single Theorems, whereby the Tangents of all Curves commonly known or considered in Geometry (the *Conical sections*, *Conchoids*, *Cissoids*, *Spirals*, *Quadratrices*, &c.) are determined in ways so general, as to comprehend also the like determination of Tangents in regard to innumerable other Curves, generated in a common manner with them. Of those five Lectures the two first are *Lematical*, or preparatory to the Demonstration of the propositions delivered in the other three; wherein yet there be some *Theorems* not unpleasant. In the *tenth* is delivered a general Analytical method of determining Tangents, extending to all sorts of Curve lines, both *Geometrical* and *Mechanical* (as Monsieur *Des-Cartes* distinguisheth.)

The *eleventh* Lecture containeth several general Theorems, about

about the Dimension of Magnitudes, or the comparison of them with one another.

To that there is subjoyned an *Appendix* concerning the dimension of Circular, and Hyperbolical segments, with divers Theorems and Rules serving to that purpose.

The *twelfth* Lecture containeth also several Theorems concerning the Dimension of Magnitudes, but chiefly respecting the dimension of Surfaces produced by the Rotation of Curve lines, and the dimension of Curve lines themselves.

To this Lecture there are also three Additaments; the *first* whereof containeth some Theorems about the dimensions of Spaces constituted by the Tangents and Secants of a Circle. The *second* shews, how the foregoing Theorems may be demonstrated by the Apagogick way, or by reduction *ad absurdum*; together with a way of finding the dimension of the surfaces of Conical bodies. In the *third* divers Problems and Theorems are added, of kin to those of the *eleventh* and *twelfth* Lecture.

The *thirteenth* Lecture propounds an Explication of the nature, and constitution of Equations, together with the variety of Roots, their Limits, &c. by construction, and consideration of certain curve lines appropriate to each Equation: with some notes respecting each particularly, and all in general.

*So much of these two Excellent Treatises*: Since the Publication of which, their worthy Author hath been pleased to communicate to a Friend of his some Corollaries, belonging to the second Problem of his third *Appendix* to the *twelfth* Lecture; which because we conceive they will be very acceptable to the Mathematical Reader, we shall here, by the Author's good leave, subjoyn them in the same Language, he hath written them in, *viz.*

*Cæterum, in multis vice, animadverto, potuisse secundo Appendiculæ tertie Lectionis XII. Problemati Corollaria quedam adponi non injucunda; qualium adscribam unum & alterum.*

Probl. 1. *Detur linea quæpiam AMB (cujus axis AD, basis DB,) curva ANE designetur talis, ut ductâ libere rectâ MNG ad BD parallela, quæ ipsam ANE secet in N; sit curva AN æqualis ipsi GM.*

*Curva ANE talis sit, ut si MT curvam AMB, & NS curvam ANE tangent, sit SG. GN :: TG. JGMq — TGq; ipsa ANE proposito faciet satis.*

Probl. 2. *Isdem quoad cætera suppositis, & constitutis, curva ANE*

*ANE jam talis esse debeat, ut curva AN semper æquetur interceptæ rectæ NM.*

*Curva ANE jam talis sit, ut sit  $SG. GN :: 2TG * GM.$   
 $CMq - Gq$ ; erit ANE curva, quæ desideratur. V. fig. eandem.*

Probl. 3. *Datur curva quæpiam DXX, cujus axis DA; reperitur  
 V. Tab. 1. n. XI. curva AMB proprietate talis, ut si libere ducatur recta  
 GXM ad ipsam AD perpendicularis, ponaturque, SMT  
 curvam AM tangere; sit MS æqualis ipsi GX.*

*Liquet rationem TG ad TM (hoc est, rationem GD ad MS, vel  
 GX,) dari; adeoque rationem TG ad GM quoque dari.*

*Infervit hoc superficiibus designandis, quarum in promptu sit dimen-  
 sio. Etenim (ductâ ME ad AD parallelâ) superficies Solidi, ex Plani  
 BME circa axem DB rotatu progeniti, æquat  $\frac{\text{Periph.}}{\text{Rad.}}$  GD $X$ ; ut habe-  
 tur in II<sup>a</sup> Lectionis XII.*

*In Lect. XI. Appendice, numero 33, de Cycloide profertur Theo-  
 rema quoddam; id quod ex hujusmodi generaliori Theoremate deduci  
 potuisset.*

*Sit AMB curva quælibet, cujus axis AD, basis DB; sit item curva  
 V. Tab. 1. n. XII. ANE talis, ut si arbitrariè ducatur PMN ad DBE  
 parallela, positæque, rectam TN curvam ANE tan-  
 gere, sit TN parallela subtensæ AM; completo rectangulo ADEG,  
 erit spatium trilineum AEG æquale segmento ADB.*

*Huic suppar theorema tale est: Iisdem positis; si tam segmentum  
 ADB, quam spatium AEG circa axem convertantur; erit productum  
 è segmento ADB solidum producti ex AEG duplum. V. fig. eand.*

*È Tangentium porrò contemplatione suborta est methodus, per  
 quam expeditissime plurima circa maximas quantitates Theoremata  
 deducuntur; quæ certè, si tempestivè se objecissent, digna censuissem  
 quæ Lectionibus insererentur: ex iis indigitabo nonnulla.*

*Sit curva quæpiam ALB, cujus axis AD, basis DB; & huic parallele  
 V. Tab. 1. n. XIII. LG, λγ; item LT curvam tangat:*

Theor. 1. *Sit m numerus quicunque potestates exponens; si po-  
 natur  $DG^{m-1} * TG = GL^m$ ; erit  $DG^m + GL^m$  maximum, seu majus  
 quàm  $D\gamma^m + \gamma\lambda^m$ .*

Th. 2. *Itidem sumpto numero m, si ponatur  $BL^{m-1} * TL = GL^m$ ;  
 erit  $GL^m + BL^m$  maximum, seu majus quàm  $\gamma\lambda^m + B\lambda^m$ .*

Th. 3. *Sint numeri quilibet m, n; si ponatur  $m * TG = n * DG$ , erit  
 $DG^m * GL^n$  maximum, seu majus quàm  $D\gamma^m * \gamma\lambda^n$ .*

Th. 4. *Quòd si ponatur  $m * TL = n * arc BL$ , erit  $GL^n * BL^m$   
 maximum, seu majus quàm  $\gamma\lambda^n * B\lambda^m$ .*

Th. 5.

Th. 5. Si fuerit  $TG \times GL = DGLB$ , erit  $DGLB \bar{x} GL$  maximum, seu majus quàm  $D\gamma^{\wedge} B \times \gamma^{\wedge}$ .

Th. 6. Sin  $TG \times GL = 2 DGLB$ , erit  $GL \times \sqrt{DGLB}$  maximum, seu majus quàm  $\gamma^{\wedge} \times \sqrt{D\gamma^{\wedge} B}$ .

Haud difficili negotio cum hæc demonstrantur, tum ejusmodi complura deprehenduntur.

III. *A Continuation of the MEMOIRES of M. Bernier concerning the Empire of the G. Mogol. English't out of French. London, Printed for Moses Pitt in Little Brittain, 1671, in 8o.*

**T**He first Volume of these *Memoires*, lately also printed in *English* for the same Bookseller, containing almost nothing but *political* affairs, was left un-mention'd in these Books; but this *second* taking notice of many particulars, relating to our design, we thought good to give it some place here; and to let the Reader know, that, besides an accurate Description of the two famous Cities of *Indostan*, *Dehli* and *Agra*, and many things discovering the *Genius* of the *Mogols* and *Indians*, as also those, which belong to their *militia*, &c. here is an account given,

*First*, of the Extravagant opinions of the Gentiles of *Indostan*; of their odd belief concerning *Eclipses*; of the Books of Sciences received amongst them; of their Doctrine of the Transmigration of Souls, and of the Creation, Preservation and Destruction of the World; as also a Relation of the different Sects of Philosophers amongst them; of their Method of *Physick*, very different from ours, and how successful; of their ignorance in, and aversion from *Anatomy*; of their pleasant Tenets in *Astronomy*, *Geography*, and *Chronology*; of their opinion concerning *Plants* and *Animals*, importing that the Seeds of both of these kinds are not form'd anew, but were contrived in the First production of the World; as also, that they are actually the very entire Plant or Animal.

*Secondly*, here is to be found a good description of the kingdom of *Kachemire*, the reputed *Paradise* of the East-Indies; its antient State; its present condition and excellencies for *Soyl*, *Vegetables*, *Waters*, *Cattel*, *Wild Dear*; the wit and Industry of the Inhabitants in making fine stuffs, good *Vernish*, &c. the condition of its Mountains, one side of them being intolerably hot, and yielding *Indian Plants*, the other very tolerable, and af-

fording none but *European* Plants; some remarkable about the Generation and Corruption of Trees there; strange *Cascata's* of water; a rare fountain, flowing, and stopping regularly thrice a day, at a certain time of the year, and at other times flowing irregularly; and a great Lake, having Ice in Summer, &c. The Scituation of the kingdoms of *Tibet*, and the Commodities they offord. A considerable account of Voyages made by Caravans from *Kachemire* through the mountains of the great *Tibet* into *Tartary* and *Cataja*; and another, of the kingdom of *Kacheguer*, with directions how to travel thither from *Kachemire*, as also, how to pass from *Kacheguer* to *Cataja*. To all which is added an Answer to some Questions touching the *Moufons* and *Rains* in *India*; the wonderful regularity of the Current of the Sea, and of the Winds there; the fertility of *Bengale*; and the Causes of the Inundation of the *Nile* and some other Rivers. The whole is concluded with a Letter concerning the Doctrine of *Atoms* and the nature of the *Mind* of Man.

*Historia & Meteorologia INCENDII ÆTNÆI, Anni 1669.*  
Joh. Alph. Borelli. *Regio Julio 1670. in 4o.*

THOUGH we have seen several Relations communicated to us of this late fire Fire of Mount *Ætna*, one of which hath been inserted in *Numb. 51.* of those Tracts; yet will it be easily allow'd by those, that shall have read and considered this Discourse, compos'd and published by the famous Philosopher and Mathematician *J. Alph. Borelli*, that all others, that have hitherto written any thing about it, must needs give the preeminence to him in respect of method, fulness, and philosophical reflexions; to the performance of which he averreth to have been induced by his Eminence the Cardinal *de Medicis* and the English *R. Society*.

The Author then having given a short *Topography* of this Mountain, delivers first a succinct Relation both of the old and later Eruptions, as also of this last Fire of *Ætna*, and withall assigneth the *perpendicular* Height of the same, shewing it not to exceed three *Italian* miles, and here taking notice of *Kepler's* assigning two such miles for the height of the Atmosphere, and thence concluding the top of *Ætna* to be considerably raised above that region of the common Air; confirming the same  
by



by a known Experience, whereby those that are on the said top at a clear break of day, may plainly see the whole Island of *Sicily*, and all the Towns thereof, as 'twere elevated and hanging in the Air, near the Eye, just as, upon the account of Refraction, stones lying at the bottom of a pond appear nigh the surface of the water.

After this, in the History it self of this Eruption he describeth particularly ;

*First*, the beginning of it, which happen'd on the 8th of *March* 1669, accompanied with Earth-quakes, and a Rent of the ground of 12 miles long, and 5 or 6 foot broad, as also with a terrible noise, roaring and cracking, vast globes of smoak first rising into the Air, and abundance of fiery melted stones being ejected soon after, which first ran like a flood of fire, and overwhelmed in a short space of time 13 towns, besides a part of the City of *Catania* it self, and afterwards were by the Air hardned into vast heaps of black and pumice-like stones, there call'd *Sciarra* ; waisting and spoiling abundance of Vines, Olives, and other plants.

The casting out of the Ashes and Sand continued for three whole months without ceasing, and filled all the neighbouring country, and cover'd all the Trees thereof for 15 miles about ; the smallest dust flying even over Sea into *Calabria* by a South-wind, and into the most Southern-parts of *Sicily* by a North-wind.

But then on the 25th of *March*, by a new Earth-quake the Top or Turret of Mount *Ætna* it self fell in, whereby was made an Opening or Cauldron of three miles in compass, and vast quantities of new matter cast out, and amongst it, abundance of fiery sand, falling down with a yet burning heat at 8 miles distance from the Cauldron ; whereupon the same by particular view and observation was found widen'd to the circumference of 6 miles. Mean while all considering men there were amaz'd at the force throwing out to so great a height such huge stones, whereof one was measur'd to be 60 palmes (or about 40 foot) long, which was faln down a mile from the Cauldron with that violence, that it was struck 30 palmes into the ground.

When this fiery Torrent assaulted *Catania* it self, and had already by its impetuosity forced from its place a whole hillock, planted with vines, belonging to the *Jesuits*, and carried them

floating, together with the soil bearing them, till it so swelled as to cover and sink them all; there appear'd some gallant persons, who by their ingenuity and extraordinary diligence, with fit Instruments, and raising vast strong walls, diverted the course of the fiery stream from that City, but chiefly by boring through the stony heaps, and thereby making passage for that current another way, and turning part of it into the Sea, wherein it made a promontory of a mile's compass before the Town.

It ceased by the 11th of *July* of the same year it began: And in *May* of 1670. our Author himself could handle without hurt the inner parts of the Cauldron and the former Torrent, and saw not so much as any smোক remaining in the highest part of that opening: Where yet he observeth, that notwithstanding this entire ceasing in the said places, there were yet found in several parts of this newly ejected *Sciarra* hot and strong-smelling fumes arising on high, especially near the walls of the South-side of *Catania*, where wells had been digged for watering their Garden fields.

This being the Breviat of the History of this Eruption, which the Author describeth with many other considerable circumstances; we proceed to acquaint the Reader, that after this Description he expatiateth into divers important speculations and remarks thereupon.

And *first* he comments upon the Form, Consistence, Bulk, and Motion of the ejected matter; taking particular notice of the great abundance of *Sal Armoniac*, that was found in all the holes and vents of the ground, and in the clefts of stones; and observing, that in three months time the fiery flood ran out 12 miles in length, and, taking the *medium*, one mile and two thirds of a mile in breadth, and stopp'd at last by the ceasing of new matter, and the condensation of the liquid matter by the cooling Air.

*Next*, he compareth together the measure of the freshly ejected matter with that of the Mountain, and finds it to equal near a fourteen thousand part of the whole Mount.

*Thirdly*, he evinceth, that Mount *Ætna* hath no such vast deep cavities, as some imagine, within its bowels near the surface of the Sea, but that there it is filled up with solid and stony matter, the huge weight of the superincumbent hill rather compressing it, than suffering any considerable hollownesse to continue therein.

*Fourthly,*

*Fourthly*, having exploded the imperfect *Meteorology*, deliver'd by the Antients of this Mountain, he discourseth of Subterraneous Heat, and deduceth the Cause of it from some concrete oleaginous and fatty substances, as sulphur, bitumen, and oyl, easily reducible into flame; examining withall, both what is the origin of such sulphureous and bituminous matter, and how that comes to take flame: Where he digresseth to shew, how Gunpowder is set on fire, after he hath described the composition, and considered the stupendious force of the same by its percussion.

*Fifthly*, he declareth, how and why the Fire in this Mountain was kindled; which he conceiveth to have been most probably done by such a way, as Quick-lime is heated by the affusion of Water; whereupon he sheweth, how Earth-quakes, Flames, and Conflagrations may have ensued.

*Sixthly*, he examines the origin and production of the fluid matter that was vitrified upon its being thrown out of this Mountain; and is of opinion (which he asserts by reason and experiment) that it was not any ignited and melted Sulphur or Brimstone, or both together, nor any metallin bodies that were converted into those vast stony and black masses, which they call *Sciarra's*, but rather Earth and Sand, together with some Alcalifat Salts, burn'd by the fervent heat of the *Ætnean* furnaces, and so turn'd into a vitreous fluor, and afterwards, upon their being cool'd by the Air, into hard substances: Explaining withall, how the Asperity and Opacity of these stones are consistent with this sentiment.

*Seventhly*, he discourseth plausibly of the Extent, Form and Scite of the *Ætnean* Furnace, and having, upon the examination of divers circumstances, found it but small and narrow, he labours to shew, how, this notwithstanding, so vast a quantity of matter, as amounts, according to his estimate, to about 100, 000, 000 cubic paces, could be therein melted and thence cast up.

*Eighthly*, he describeth the burning down and falling in of the highest top of *Ætna*.

*Ninthly*, he inquireth into the Generation of those Sands abovementioned, and withall giveth an account, why in the New opening of *Ætna* there were heard such terrible and perpetual Thundering noises, as also, by what cause and force those Sands were thrown out; shewing withall, that they were really Sands,

not *Ashes*, and solving Objections alledged against it.

*Tenthly* he concludeth, that since, by his calculation, the upper part of Mount *Ætna* hath been just so much depressed, as the mass of sand and stones ejected amounts to, this mass was furnish't by the Mountain it self, and from the Earth and Sands thereof produced and vitrified: where he taketh pains to make it appear, how all that prodigious quantity of matter, thrown out both now and in former ages, and seeming far to exceed the bulk of this whole Mountain, could be furnish't by *Ætna* it self, and yet the same not be quite levelled with the ground: The like of which he considers of Mount *Vesuvius*.

*Eleventhly*, he taketh particular notice, that, whereas the Fires were soon extinguish't in the place of the very Pit of the Sulphur and Bitumen, yet they lasted long in other places, that were waterish and destitute of combustibile fatness; endeavouring to render a reason of this *phenomenon*.

*Twelfthly*, he inserts an Observation of great plenty of *Sal Armoniac*, cast out in this *Incendium*, which, he saith, was seen adhering both to the corners and asperities of the *Sciarra*, and to the sides of the rents made in those huge stones, which the ejected matter was at length hardned into. And of this Salt he affirms, that there had been sublimed, (for he makes it *factitious*) so great store, that many thousands of pounds might be gather'd; adding, that even a whole year after the extinction of the Fire in the Mouth's of *Ætna*, there were found remaining divers vents about *Catania*, exhaling store of smoak, which had the like *Sal Armoniac* sticking to the sides and edges of the Stones.

*Lastly*, he rejecteth the opinion of those, that will maintain the *Ætnean* Fires to have been perpetual and never extinguish'd, asserting the frequent cessation of them, and withall assigning the cause of that cessation, as well as that of their renovation. Concerning which, and many other considerable remarks and reflections, too many to be here recited, we refer the Reader to the Book it self.