



Rev. COTTON MATHER

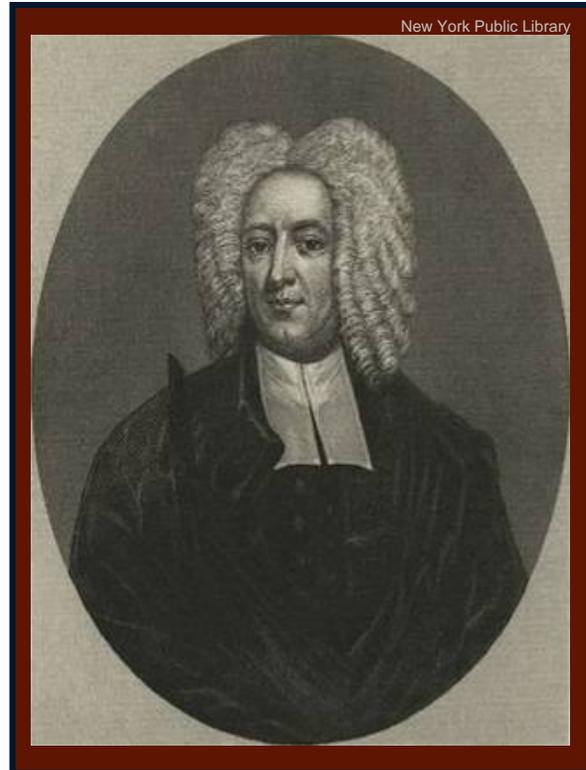
The Christian Philosopher

*A Collection of the Best Discoveries in Nature,
 with Religious Improvements*

1721, EXCERPTS

Cotton Mather, the Puritan clergyman who published hundreds of sermons and theological works, also produced the first American compilation of scientific knowledge, *The Christian Philosopher*. (The term “natural philosophy” referred to the pursuit of scientific knowledge; thus the “Christian philosopher” studied scientific knowledge within the perspective of Christian theology.) For Mather, science was an “incentive to Religion” that fostered reverence and moral insight. “Theologians had long studied nature in order to understand the will of God,” asserts historian Winton Solbert. “Now they and their allies welcomed scientific advances that explained how God’s Providence advanced divine purposes in the physical universe. Mather always saw harmony rather than conflict between science and religion.”¹

Presented here is a representative sampling of Mather’s review of scientific knowledge—the “Works of the glorious God exhibited to our View.” The brief excerpts from each chapter reveal Mather’s respect for scientific inquiry and his spiritual devotion in response to the natural world.



THE INTRODUCTION_____

The ESSAYS now before us will demonstrate that *Philosophy* [science] is no *Enemy*, but a mighty and wondrous *Incentive to Religion*; and they will exhibit that PHILOSOPHICAL RELIGION, which will carry with it a most sensible *Character* and victorious *Evidence* of a *reasonable Service*. *GLORY TO GOD IN THE HIGHEST*, and *GOOD WILL TOWARDS MEN*, animated and exercised; and a Spirit of *Devotion* and of *Charity* inflamed, in such Methods as are offered in these *Essays*, cannot but be attended with more Benefits, than any *Pen* of ours can declare or any *Mind* conceive. . . .

The Works of the Glorious GOD in the *Creation* of the World are what I now propose to exhibit in brief *Essays* to enumerate *some of them*, that He may be glorified in them. . . .

ESSAY I: *Of the LIGHT*.____ . . .

The Light calls first for our Contemplation. A most marvelous Creature, whereof the Great God is the *Father*. . . .¹

It is proved by Mr. [William] *Molyneux*² that *Light* is a *Body*. Its *Refraction*, in passing through a *Diaphanous Body*, shows that it finds a different *Resistance*. *Resistance* must proceed from a Contact of *two Bodies*. Moreover, it requires *Time* to pass from one place to another, though it has indeed the quickest of all Motions. . . .

Sir *Isaac Newton* judges, 'Tis probable that *Bodies* and *Light* act mutually on one another — *Bodies* upon *Light* in emitting it, and reflecting it, and refracting it, and inflecting it; *Light* upon *Bodies* by heating them and putting their Parts into a Vibrating Motion. . . .

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¹ Adapted from James 1:17. [New Testament]

² See list of scientists cited by Mather on page 13.

The Christian Philosopher

TABLE OF CONTENTS

- | | |
|------------------------------------|-------------------------------------|
| 1. Of the LIGHT. | 17. Of the AIR. |
| 2. Of the STARS. | 18. Of the WIND. |
| 3. Of the FIXED STARS. | 19. Of the COLD. |
| 4. Of the SUN. | 20. Of the Terraqueous |
| 5. Of SATURN. | GLOBE [Earth]. |
| 6. Of JUPITER. | 21. Of GRAVITY. |
| 7. Of MARS. | 22. Of the WATER. |
| 8. Of VENUS. | 23. Of the EARTH. |
| 9. Of MERCURY. | 24. Of MAGNETISM. |
| 10. Of COMETS. | 25. Of MINERALS. |
| APPENDIX: Of HEAT. | 26. Of the VEGETABLES. ¹ |
| 11. Of the MOON. | 27. Of INSECTS. |
| 12. Of the RAIN. | 28. Of REPTILES. |
| 13. Of the RAINBOW. | 29. Of the FISHES. |
| 14. Of the SNOW. | 30. Of the FEATHERED. ² |
| 15. Of the HAIL. | 31. Of the FOUR-FOOTED. |
| 16. Of the THUNDER &
LIGHTNING. | 32. Of MAN. |

¹ Plants. ² Birds.

We suppose the Distance of the *Sun* from the Earth to be 12,000 Diameters of the Earth, or suppose 10,000. The *Light* then runs 1000 Diameters in a Minute; which is at least 130,000 Miles in a Second. Dr. [George] *Cheyne* shows that *Light* is about six hundred thousand times more swift then *Sound*. Amazing Velocity! . . .

I have a most Glorious Redeemer, of whom I am assured that he is the *true LIGHT* and the *LIGHT of the World*. . . .³

For the *Light of Reason*, which *enlightens every Man that comes into the World*;⁴ every Man has all possible Reason to glorify *GOD* and never do any thing whereof any Man may justly say. *It seems to me unreasonable*. . . .⁵

ESSAY II: Of the STARS. _____ . . .

The learned [Christiaan] *Huygens* has a Suspicion that every *Star* may be a *Sun* to other Worlds in their several *Vortices*. Consider then the vast Extent of our *Solar Vortex* and into what Astonishments must we find the Grandeur and

Glory of the Creator to grow upon us! Especially if it should be so (as he thinks) that all these Worlds have their Inhabitants, whose Praises are offer'd up unto our *GOD*! . . .

The TELESCOPE, invented the Beginning of the last Century, and improved now to the Dimensions even of *Eighty Feet*, whereby Objects of a mighty Distance are brought much nearer to us, is an Instrument wherewith our Good *GOD* has in a singular manner favoured and enriched us — A *Messenger* that has brought unto us, from very distant Regions, most wonderful Discoveries.

My GOD, I cannot look upon our Glasses without uttering thy Praises: By them I see thy Goodness to the Children of Men! . . .⁶

According to Mr. *Huygens*, the Distance of the *Sun* from us is 12,000 Diameters of the Earth. A Diameter of the Earth is 7,846 Miles. The Distance of the nearest *Fixed Stars* from us, compared with that of the *Sun*, is as 27,664 to 1. So then the Distance of the nearest *Fixed Stars* is at least 2,404,520,928,000 Miles, which is so great that if a Cannon-Ball (going all the way with the same Velocity it has when it parts from the Mouth of the Gun) would scarce arrive there in 700,000 Years. *Great God, what is thy Immensity!* . . .

ESSAY III: Of the FIXED STARS. _____

Our Great Prospective⁷ having made Enquiry, finds a far greater Number of Stars than that we can discern with the naked Eye.



Oxford Museum of the History of Science
Gregorian reflecting telescope, English, ca. 1710

³ Adapted from John 1:9, 12:46.

⁴ John 1:9.

⁵ Acts 25:27.

⁶ Adapted from Psalms 107:8, 15, 21, 31.

⁷ Deuteronomy 32:3.

The Ancients reckon'd only *One Thousand and Twenty Two* Stars in their Constellations. *Kepler* augments the Number to *One Thousand Three Hundred and Ninety Two*. . . The Number of the Stars, brought down into our *latest Globes* is about *Nineteen Hundred*, but those in the Heavens are inconceivably more. . . .

ESSAY IV: *Of the SUN.*_____ . . .

Sir *Isaac Newton*, as well as Dr. *Hooke*, takes the *Sun* to be a solid and opaque Body. Dr. *Hooke* thinks this Body to be encompassed with a vast Atmosphere, the Shell whereof is all that Shines. The *Light* of the Sun he takes to be from the Burning of the more superficial Parts, which are set on fire, which may be without hazard of being burnt out in a vast Number of Ages. And Sir *Isaac Newton* thinks the *Sun* to be a sort of a mighty Earth, most vehemently hot; the Heat whereof is conserved by the marvelous Bigness of the Body, and the mutual Action Re-action between *That* and the *Light* emitted from it. . . .

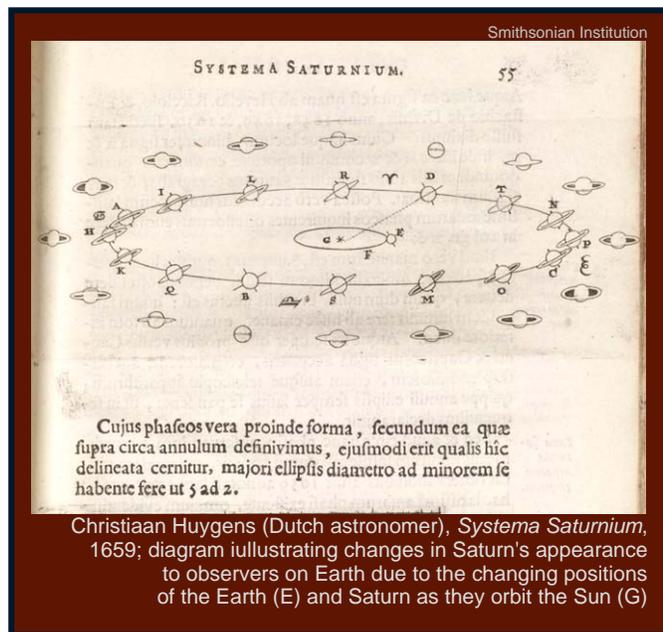
The apparent Diameter of the *Sun* being sensibly greater in *December* than in *June*, it is plain, and Observation confirms it, in *Summer*. It is also confirmed by the Earth's moving swifter in *December* than in *June*, which it does about five Fifteenths. And for this reason there are about eight Days more from the *Sun's* vernal *Equinox* to the autumnal, than from the autumnal to the vernal. . . .

Mr. [Thomas] *Tompion's* Observations from the *Equation of natural Days* render it evident that the Motion of the Sun (if we must speak in those Terms) must be swifter at some times than at others. *Great GOD, the Motion is always under thy Glorious Guidance!* . . .

ESSAY V: *Of SATURN.*_____

All the *Master Planets*, as they may be called, move about the *Sun* as their *Common Center*. They move with different Velocities, but there is this Common Law observed in all of them: *That the Squares of the Times of their Revolutions are proportional to the Cubes of their Distances*. . . ⁸ Who but the Great GOD could make and fix these Laws? Lord, they continue this day according to thine Ordinances, for all are thy Servants.⁹

It is now found that *Saturn*, besides his round *Body*, has also a luminous *Ring* which encompasses him, as the Horizons of our Artificial Globes do usually encompass them; and is flat upon the *Verge* as they use to be. The *Ring* shows itself in an Oval and at certain times it wholly disappears. . . .



Christiaan Huygens (Dutch astronomer), *Systema Saturnium*, 1659; diagram illustrating changes in Saturn's appearance to observers on Earth due to the changing positions of the Earth (E) and Saturn as they orbit the Sun (G)

ESSAY VI: *Of JUPITER.*_____

Jupiter's Globe, according to [Giovanni Domenico] *Cassini's* Measures, must be greater than that of the Earth by 2460 Times. The periodical Time of his Revolution about the *Sun* is Twelve Years or 4380 Days. . .

ESSAY VII: *Of MARS.*_____ . . .

The Year of Mars is near twice as long as ours, his Natural Day a little greater than ours. . . .

It is thought that *Mars* has an *Atmosphere*, because *Fixed Stars* are obscured, and as it were extinct, when they are seen just by his Body.

⁸ Kepler's third law of planetary motion, first published in 1618.

⁹ Psalms 119:91.

ESSAY VIII: Of VENUS._____ . . .

*Herigone and Keplerus and Rhætensis*¹⁰ conclude that *Venus* moves about its Axis in about fourteen Hours. Dr. *Cheyne* says in twenty-three.

ESSAY IX: Of MERCURY._____ . . .

The Planet has his Abode so near the Sun that as yet there has been little discovered of him. . . .
 Sir *Isaac Newton* has terrible Apprehensions of the Heat in this Planet as being seven times as much as the Heat of the Summer-Sun in *England*, which according to his Experiments made by the Thermoscope would be enough to make Water boil. . . .
 But let us now entertain ourselves with a *Synopsis* of certain Matters relating to the Planets, as they are determined by the latest and most accurate Astronomers.¹¹

	<i>The Distance from the Sun in English Miles</i>	<i>The Diameter in English Miles</i>	<i>The Time of the Periodic Revolution</i>	
			Days	Hours
Of Mercury	32,000,000	4,240	87	23
Venus	59,000,000	7,906	224	17
The Earth	81,000,000	7,935	365	6
Mars	123,000,000	4,444	686	23
Jupiter	424,000,000	81,155	4,332	12
Saturn	777,000,000	67,870	10,759	7

. . .
*Great GOD, thou hast lifted me up to Heaven: Oh! let me not be cast after all down to Hell. . . .*¹²

ESSAY X: Of COMETS._____

'Tis an admirable Work of our GOD that the many *Globes* in the Universe are placed at such Distances as to avoid all violent Shocks upon one another, and everything wherein they might prove a prejudice to one another.
 Even Comets, too, move so as to serve the Holy Ends of their Creator! COMETS, which are commonly called *Blazing Stars*, appear unto later Observations to be a sort of *Eccentric Planets* that move periodically about the Sun.
 Sir *Isaac Newton*, from whom 'tis a difficult thing to dissent in anything that belongs to *Philosophy* [science], concludes that the Bodies of *Comets* are solid, compact, fixed, and durable, even like those of the other Planets. . . .

APPENDIX: Of HEAT._____

We should be forgetful if we take our leave of the Heavenly Bodies and say nothing of *Heat*, whereof they have so much among them. . . .
 The Intenseness of *Heat* (as of *Light*) always is as the *Density* of the Rays, or Particles of *Fire*, that occasion [cause] it, and this *Density* is as the *Distance* from the radiating Point reciprocally. . . .

¹⁰ Pierre Hérigone, Johannes Kepler, and George Joachim Rhæticus, European mathematician-astronomers. [NHC note]
¹¹ Sources: NASA, 2008; Space Science Laboratory, University of California, Berkeley.

	<i>The Distance from the Sun in English Miles</i>	<i>The Diameter in English Miles</i>	<i>The Time of the Periodic Revolution</i>	
			Days	Hours
Of Mercury	35,983,610	3,032	87	23
Venus	67,232,360	7,521	224	17
The Earth	92,957,100	7,926	365	6
Mars	141,635,300	4,222	686	22
Jupiter	483,632,000	88,846	4,330	14
Saturn	888,188,000	74,898	10,755	17

¹² Adapted from Matthew 11:23.

ESSAY XI: *Of the MOON.*_____

We are now coming down unto our *Terraqueous Globe* [Earth]. The MOON, a sort of *Satellite* unto this Globe, salutes us in our Way. Paying an Homage to none but her Glorious Maker, we will now behold her *walking in her Brightness*.¹³

What shall we think of the *Protuberant Parts* observed on that Celestial Body? What of the *Round Hollows*, like Pits or Wells of several Magnitudes, which have been formerly mistaken for *Mountains*? . . .

The *Moon* is almost one Semidiameter of the Earth nearer to us when she is in the *Meridian* than when she is nigh the *Horizon*. But why doth she then appear bigger to our sight when she is nigh the *Horizon* than when she is in the *Meridian*? Dr. [John] Wallis agrees with [René] Descartes in the Solution — the Horizontal *Moon* is capable of being compared with many intervening Objects, Hills, Trees, and the like, but the Meridian *Moon* hath nothing to be compared with. . . .

ESSAY XII: *Of the RAIN.*_____

We are now coming down into our *Atmosphere*. Here we are quickly surrounded with *Clouds*. And here we quickly find ourselves in the midst of that Rain, whereof the Great GOD, in his Book, so often claims the *Glory* of being the Maker and *Giver*.

The *Rain* is Water by the *Heat* of the *Sun* divided into very small and invisible Parts which, ascending in the *Air* till it encounters with the *Cold* there, is by degrees condensed into *Clouds*, and thence descends in *Drops*. . . .

When GOD *gives Rain from Heaven*, he will give also *fruitful Seasons* in our Minds,¹⁴ if they be thereby led to due Acknowledgments of him. 'Twill bespeak, 'twill procure, the richest *Showers of Blessings*¹⁵ upon us. How seasonable will it be for us now “humbly to acknowledge the *Witness*, which our GOD gives us of his *Power* and *Goodness!* . . .”

ESSAY XIII: *Of the RAINBOW.*_____

[Mather summarizes hypotheses on the rainbow from the Roman era through the Renaissance.] . . . But then comes the admirable Sir *Isaac Newton*, whom we now venture to call the *Perpetual Dictator*¹⁶ of the learned World in the *Principles of Natural Philosophy*; and than whom there has not yet shone among Mankind a more sagacious Reasoner upon the *Laws of Nature*. This rare Person, in his incomparable Treatise of *Optics* [1704], has yet further explained the Phenomena of the Rainbow; and has not only shown how the *Bow* is made but how the *Colours* (whereof Antiquity made but *Three*) are formed; . . .

ESSAY XIV: *Of the SNOW.*_____ . . .

Though the *Snow* seem soft, yet it is truly *hard*; it is *Ice*; but the *Softness* of it is from this — Upon the first Touch of the *Finer* on the sharp Edges, it thaws immediately; the Points would else pierce the Fingers like so many Lancets.

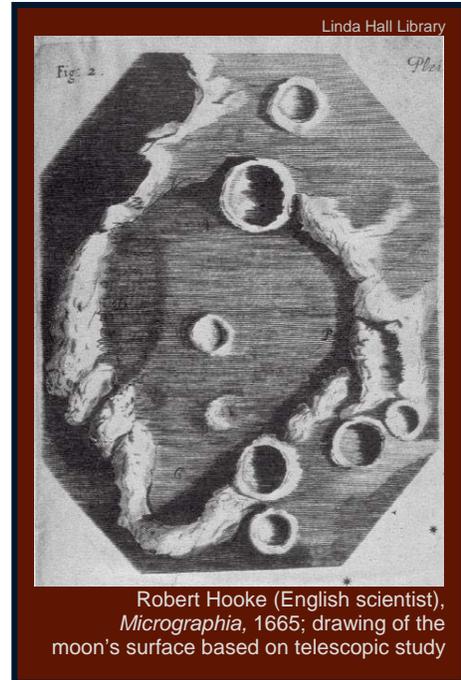
Again, through the *Snow* be true *Ice*, and so hard and so dense a Body, yet it is very *light*. This is because of the extreme *Thinness* of each *Icicle* in comparison of the *Breadth*. As *Gold*, though the most ponderous of all Bodies, beaten into Leaves, rides on the least Breath of Air. . . .

¹³ Deuteronomy 4:24, 9:3, and Hebrews 12:29.

¹⁴ Adapted from Acts 14:17.

¹⁵ Ezekiel 34:26.

¹⁶ I.e., one who dictates with authority (not referring to a tyrannical ruler). [NHC note]



ESSAY XV: *Of the HAIL.*_____ . . .

Hail is very often a Concomitant of *Thunder* and *Lightning*. 'Tis well known, as Dr. [John] *Wallis* observes, that in our *Artificial Congelations* [congealings], a Mixture of *Snow* and *Nitre*,¹⁷ or even common *Salt*, will cause a very sudden Congelation of *Water*. Now the same in the *Clouds* may cause *Hail-Stones*; and the rather, because not only in some that are prodigiously great, but also in common *Hail-Stones*, there seems to be something like *Snow*, rather than *Ice*, in the midst of them. . . .

ESSAY XVI: *Of the THUNDER & LIGHTNING.*_____

His *powerful Thunder*, who can understand?¹⁸ Yet our *Philosophy* will a little try to see and say something of it. . . .

Dr. *Wallis* observes that *Thunder* and *Lightning* have so much resemblance to *fired Gunpowder* in their *Effects* that we may very well suppose much of the same *Causes*. . . This *Explosion*, high in the *Air* and far from us, will do no considerable mischief. But if it be very near us, it has terrible *Consequences*. . . .

ESSAY XVII: *Of the AIR.*_____ . . .

The *Weight of Air* was discover'd first by *Galileus*, who finding that *Water* could not by pumping be raised any higher than 34 or 35 Foot, concluded that the old *Notion* of an infinite *Fuga Vacui* ["avoidance of a vacuum"] would never do, and so fell to thinking on the *Counterbalance* of the *Weight of the Air*. . . .

Mr. [Robert] *Boyle* found by repeated *Experiments* that the *Weight of Air* to *War* is as 1 to 1000. . . .

Sir Isaac Newton thinks *true and permanent Air* to be made by *Fermentation* and *Rarefaction* of *Bodies* that are of a very fixed *Nature*. And it is plain those *Particles* fly and avoid one another with the greatest *Force at a distance*, which when they are very near do attract and adhere to one another with the greatest *Violence*. . . .

It is admirable to consider the *Necessity of Air* to the whole *animal World*; how soon the *vital Flame*¹⁹ does languish and expire, if *Air* be withheld from it! Even the *Inhabitants* of the *Water* cannot live without the *Use* of it. . . .

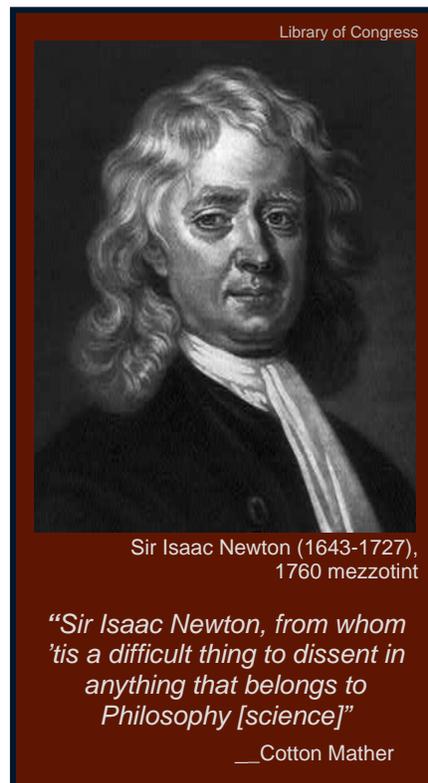
ESSAY XVIII: *Of the WIND.*_____

What better definition of the *Wind* than *the Stream of the Air*? *Plato* long since defin'd it, *The Motion of the Air about the Earth*.

Other *Hypotheses* for this *Current of the Air* not well answering all *Phenomena*, the learned Mr. [Edmond] *Halley* recommends this to *Consideration* as the *Cause* of it — The *Action of the Sun-beams* on the *Air* and *Water*, as the *Sun* passes every day over the *Oceans*, consider'd with the *Nature of the Soil* and the *Situation of the Continents* adjoining. . . .

The inquisitive and ingenious Mr. [William] *Derham* found by many *Trials*, That the *Wind* in a great *Storm* does move about *fifty* or *sixty Miles* in an *Hour*, that a common brisk *Wind* moves about *fifteen Miles* an *Hour*. But so gentle is the *Course* of many *Winds* that they do not exceed *one Mile* an *Hour*. . . .

What amazing things the *Winds* called the *Tuffoon*, (or *Typhons!*) and how irresistibly furious! But our merciful *God* stays the rough *Winds*.²⁰



¹⁷ Saltpeter, i.e., potassium nitrate or sodium nitrate.

¹⁸ The reference is to Exodus 9:18-35 and Revelation 16:21. [Footnote continues.]

¹⁹ The concept of a vital flame held that a fine and kindled substance resides in the heart of animals and that air taken in by respiration is necessary to the preservation of this vital flame.

²⁰ Adapted from Isaiah 27:8.

The *Hurricanes* in the *West Indies*, and their Brethren the *Monsoons* in the *East*; what shocking Stories do the Travellers give us of them! How direful Effects are sometime caused by them! They blow down mighty *Trees* by the Roots. They chase mighty *Ships* up into the Woods. They make everything to tremble and give way, that is in their way. *Great God, who ridest on the Wind, and makest it move which way thou shalt please; who can stand in thy sight, if thou art angry!* . . .

ESSAY XIX: Of the COLD.____ . . .

The Force of the *Cold* is truly wonderful. [Adamus] *Olearius* tells us in Muscovy²¹ their Spittle will freeze e'er it reach the Ground. So violent the *Cold* there that no *Furs* can hinder it, but sometimes the *Noses*, the *Ears*, the *Hands*, and the *Feet* of Men will be frozen and all fall off. . . Captain [Thomas] *James* and *Gerat* [*Gerrit*] *de Veer* tell us frightly things of the Cold they found on their Northern Coasting. . . .²²

Was it not then a Mistake in *Pliny*,²³ when Ice was defined by him, *Aquae Copia in Augusto*?²⁴ The *Dimensions* of Water are increased by *Freezing*; and with such a Force in the Expansion that the *Weights* raised by it, the *Stones* broke in it, the *Metals* obliged to give way to it, were hardly credible if these Eyes had not seen them! . . .

ESSAY XX: Of the TERRAQUEOUS GLOBE.____

The Distance at which our *Globe* is placed from the *Sun*, and the Contemperation of our Bodies and other Things to this Distance, are evident Works of our Glorious GOD! . . .

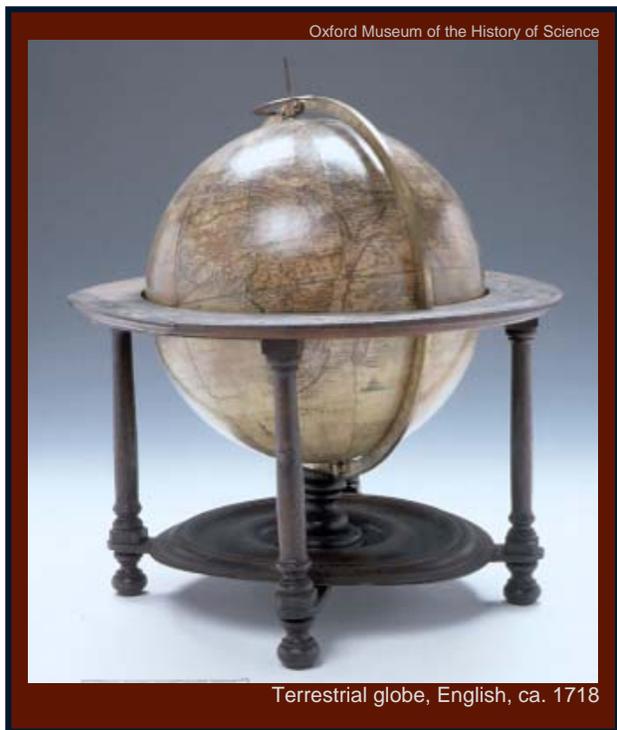
The Figure of our *Globe* is most probably that of an Oblate Spheroid. It swells towards the Aequatorial Parts, and flats toward the Polar. According to Sir *Isaac Newton*, the Diameter of the *Globe* is about thirty-four Miles longer than the Axis. . . .

Mr. *Halley* shows the annual Motion of the Earth to be so swift as far to exceed that of a Bullet shot out of a Cannon, and to be after the rate of 210 Miles in a Minute and 12,600 Miles in an Hour. . . .²⁵

ESSAY XXI: Of GRAVITY.____ . . .

A most noble Contrivance (as Mr. *Derham* observes) to keep the several Globes of the Universe from shattering to pieces, as they would else evidently do in a little Time, through their swift Rotation round their own *Axes*. Our *Globe* in particular, which revolves at the rate of above a thousand Miles an Hour, would, by the centrifugal Force of that Motion, be soon dissipated and spirtled²⁶ into the circumambient Space, were it not kept well together by this wondrous Contrivance of the Creator, *Gravity*, or the *Power of Attraction*. . . .

All Bodies descend still towards a Point, which either is, or lies near to, the *Center* of the *Globe*. Should our Almighty GOD change that *Center* by the two thousandth part of the *Radius* of our *Globe*, the Tops of our highest Mountains would be soon laid under Water. . . .



²¹ Russian political entity (1340-1547) centered on Moscow. [NHC note]
²² Men on expeditions in search of a northwest and a northeast passage, respectively, from Europe to Asia. [NHC note]
²³ Pliny the Elder (A.D. 23-79), Roman naturalist. [NHC note]
²⁴ "A quantity of water in a small space."
²⁵ The earth spins on its axis at about 1040 miles an hour (about 18 miles a minute), and moves around the sun at about 67,000 miles an hour. (NASA.) [NHC note]
²⁶ A spirtle is a small spirt or jet, so the meaning is, to be whirled into space.

ESSAY XXII: Of the WATER._____ . . .

According to Mr. *Halley's* Experiment, *Water* as warm as the *Air* in the *Summer* will in *twelve Hours* exhale the *tenth part* of an *Inch*. This *Quantity* will be found abundantly sufficient for all the *Rains* and all the *Dews* and all the *Springs* in the *World*, and will account for the *Caspian Sea* and our vast *Canadian Lakes*, . . .

Dr. *Cheyne* has taught me to take notice of one thing more. If our *Earth* had any more than *one Moon* attending it, we should receive probably a *Detriment* from it rather than an *Advantage*. For at the *Conjunction* and *Opposition* with one another, and with the *Sun*, we should have *Tides* that would raise the *Waters* to the *Tops* of our *Mountains*, and in their *Quadratures*²⁷ we should have no *Tides* at all. . . .

ESSAY XXIII: Of the EARTH._____

*The Lord by Wisdom has founded the Earth.*²⁸ A poor *Sojourner* on the *Earth* now thinks it his *Duty* to behold and admire the *Wisdom* of his glorious *Maker* there. . . .

The sagacious Dr. *Halley* has observed that the *Ridges* of *Mountains*, being placed through the midst of their *Continents*, do serve as *Alembics*²⁹ to distill fresh *Waters* in vast *Quantities* for the *Use* of the *World*; And their *Heights* give a *Descent* unto the *Streams* to run gently, like so many *Veins* of the *Macrocosm*, to be the more beneficial to the *Creation*. . . .

What *Rivers* could there be without those admirable *Tools of Nature!* . . .

ESSAY XXIV: Of MAGNETISM._____ ³⁰

Such an unaccountable thing there is as *the MAGNETISM of the Earth*. A *Principle* very different from that of *Gravity*.

The *Operations* of this amazing *Principle* are principally discovered in the communion that *Iron* has with the *Lodestone*, a rough, coarse, unsightly *Stone*, but of more *Value* than all the *Diamonds* and *Jewels* in the *Universe*. . . .

If two *Magnets* are spherical, one will conform itself to the other, so as either of them would do to the *Earth*; and after they have so turned themselves, they will endeavour to approach each other: but placed in a contrary *Position*, they avoid each other.

If a *Magnet* be cut through the *Axis*, the *Segments* of the *Stone* which before were joined will now avoid and fly each other. If the *Magnet* be cut by a *Section* perpendicular to its *Axis*, the two *Points* which before were conjoined will become contrary *Poles*: one in one, t'other in t'other *Segment*. . . .

Once for all, *Gentlemen Philosophers*, the *MAGNET* has quite *puzzled* you. It shall then be no indecent *Anticipation* of what should have been observed at the *Conclusion* of this *Collection*, here to demand it of you, that you glorify the infinite *Creator* of this, and of all things, as *incomprehensible*. You must acknowledge that *Human Reason* is too feeble, too narrow a thing to comprehend the *infinite God*. . . .



²⁷ The position of the Moon or a planet when it is at right angles to the Sun. [NHC note]

²⁸ Proverbs 3:19.

²⁹ An alembic is anything that distills, refines, or purifies.

³⁰ The greater length of these final chapters is not represented in the length of the excerpts presented here, which are meant to provide a sense of Mather's scientific and theological goals in *The Christian Philosopher*. [NHC note]

ESSAY XXV: *Of MINERALS.*_____ . . .

What *Vessels*, what *Buildings*, what *Ornaments*, do these afford us, especially the *Slate*, the *Marble*, the *Free-stone*,³¹ and the *Lime-stone*? How helpful the *Warming-Stone*?³² How needful the *Grind-stone* and *Mill-stone*? . . .

How amazingly serviceable is our Iron to us! In our mechanical Arts, in our Agriculture, in our Navigation, in our Architecture; in all, I say, all our Business! What a sordid Life to those Barbarians lead who are kept ignorant of it! Unthankful for this, O Man, you deserve Heaven should become as Iron over you.

It is from GOD that the *Metals* of most necessary Uses are the most plentiful; others that may be better spared, there is a rarity of them. . . .

ESSAY XXVI: *Of the VEGETABLES [PLANTS].*_____

The Contrivance of our most Glorious Creator in the VEGETABLES growing upon this Globe cannot be wisely observed without Admiration and Astonishment.

We will single out some remarkables, and glorify our GOD! . . . Mather reviews what is known of plant physiology, respiration, etc.]

Every particular *part* of the *Plant* has its astonishing Uses. The *Roots* give it a Stability and fetch the Nourishment into it, which lies in the Earth ready for it. The *Fibers* contain and convey the Sap which carries up that Nourishment. The *Plant* has also larger Vessels which entertain the proper and specific Juice of it, and others to carry the Air for its necessary respiration. . . .

Our Saviour says of the *Lillies* (which some, not without reason, suppose to be *Tulips*) that Solomon *in all his Glory was not arrayed like one of these*. . . .³³

Indeed all the *Plants* in the whole *Vegetable Kingdom* are, every one of them, so *useful* as to *rise up* for thy *Condemnation, O Man, who dost little Good in the World*. But sometime the Uses of one *single Plant* are so many, so various, that a wise Man can scarce behold it without some *Emulation* as well as *Admiration*, . . .

ESSAY XXVII: *Of INSECTS.*_____

We are hastening into the Animal World. Here we soon find a Tribe vastly numerous, called by Aristotle έντομα³⁴ and by *Pliny* therefore *Insecta*, because of their having certain Incisures and Indentings about their Bodies.

The *French Philosopher*³⁵ does well to rebuke us for calling these *imperfect Animals*, for they want [lack] no Parts, either *necessary* or convenient for them. They are *complete* in their Kind, and the Divine Workmanship is astonishing! . . .

Even the poor *Ephemeron*,³⁶ whose whole period of Life is but six or seven Hours, who is bred and born and lives and goes through all his Operations, and expires, and goes into his Grave, all within this



Caspar Commelin (Dutch botanist), *Praeludia botanica* . . . , 1703; illustration, "Geranium africanum"

³¹ A stone (such as sandstone or limestone) which can be cut freely in any direction without splitting.

³² Probably coal or any stone that, once heated, would retain heat for a long time. It was put in a warming pan and used to warm a bed.

³³ Matthew 6:29.

³⁴ *Entoma*, or "insects."

³⁵ Nicolas Andry.

little Period, must not be thrown into a Class of *imperfect Animals*, nor may it be said of it that it is *made in vain*. . . .³⁷

There is one more thing more to be added: That the Numbers of *Insects* and *Vermin* may not be too offensive to us, Providence has ordained many Creatures, especially such as are in superior Orders, to make it their business to destroy them, especially when their Increase grows too numerous and enormous. . . Hideous Armies of *Worms* do sometimes visit my Country and carry whole *Fields* of Corn before them, and climbing up Trees, leave them as bare as the middle of *Winter*. Our *wild Pigeons* make this the *Season* of their *Descent*, and in prodigious Flocks they fall upon these Robbers and clear the Country of them. . . .



ESSAY XXVIII: *Of REPTILES.*_____

Let us now handle the *Reptiles*, which are a sort of *Animals* that rest one part of their Body on the Earth while they advance the other forward. . . .

There is abundance of *geometrical* Neatness and Niceness in the Motion of *Serpents*; their *annular Scales* lie cross their Belly, contrary to what those in the Back and the rest of the Body do: the Edges also of the *foremost Scales* lie over the Edges of the *following Scales*, and every Scale has a *distinct Muscle*, one end of which is tack'd to the middle of the Scale, the other to the upper Edge of the following Scale. . . .

Let it be considered that the venomous Creatures have their great *medicinal Uses*. We see a *Treacle*³⁸ fetch'd out of a *Viper*. The *Viper's* Flesh cures *Leprosies* and obstinate Maladies. The *Gall* of a *Rattle-snake* (which we take out of him in the more early Months of his yearly appearance and work into *Troches*³⁹ with *Chalk* or *Meal*) is a rich *Cordial* and *Anodyne*, for which purpose I have often taken it and given it. It invigorates the Blood into a mighty *Circulation*, . . .

ESSAY XXIX: *Of the FISHES.*_____ . . .

Let us become *Divers* and visit the *watery World*. There we shall see, as Mr. *Derham* truly says, a *various, a glorious, an inexhaustible Scene of the Divine Power, Wisdom and Goodness*. . . .

The *Air-bladder*, wherewith most of the *Fishes* are furnished: this is what cannot be beheld without Astonishment! By this they poise their Bodies and keep them equiponderant to the Water. Without it they would fall to the bottom and lie groveling there, as it has been found when that *Wind-bladder* has been broken. By *contracting* or *dilating* this Bladder, they are able to sink or to raise themselves at their pleasure and continue in any depth of Water they please.

Fishes are *sensible* of *Sounds*, but whether they *hear*, or only *feel*, the *Sounds* is very much disputed. . . .

What a vast Supply of our Food have we in *sucking the Abundance of the Seas*?⁴⁰ How many Millions of the *Fish* are every Year fetch'd out of their Element and interr'd in the hungry Bowels of *Men*? . . .

³⁶ That is, the mayfly, any member of the insect order Ephemeroptera. The nymphs are aquatic and usually live in clear water for one to four years before emerging in great numbers. The adults usually live only a few hours.

³⁷ Adapted from Psalms 89:47 and Jeremiah 8:8; cf. Isaiah 45:18.

³⁸ That is, a remedy for poison. Mather published anonymously a discourse entitled *A Treacle Fetch'd Out of a Viper* (Boston, 1707).

³⁹ That is, a small, usually round, medicinal lozenge.

⁴⁰ Deuteronomy 33:19.

ESSAY XXX: *Of the FEATHERED.*_____

The BIRDS now invite us to *soar* and *sing* with them in the Praises of our God. . . .

Their *Feathers*, how artificially placed for facilitating the motion of their Body! Being placed any other way than what they are (as they would have been if mere *Chance* had placed them) they would have gathered Air and been an Encumbrance to the Passage of their Body through the *Air*; whereas in the neat *Order* wherein they are now placed, they are like a Boat new dress'd and clean'd, making its Passage through the Waters. . . .

The *Flight* performed according to the strictest Rules of *Mechanism*! The untaught Artist gives a motion to his Wings, than which the acutest Mathematician could not give one more agreeable.

Blind Philosopher, canst thou see no GOD in all of this? . . .

Shall we stop a Moment and consider how useful the carnivorous Birds of Prey become, even in prosecuting their voracious Inclinations? If the number of *lesser Birds* were not by their means lessened into such a Proportion, those *lesser Birds* would *overstock their feeding*; and then also should those *lesser Birds*, which are so numerous, die of Age, they would leave their *Carcasses* to rot upon the Ground, and their *Stink* would corrupt the Air and become insupportable. . . .

ESSAY XXXI: *Of the FOUR-FOOTED.*_____

We proceed to the *Animals* that are perfect, hairy, and *walking upon four*. . . .

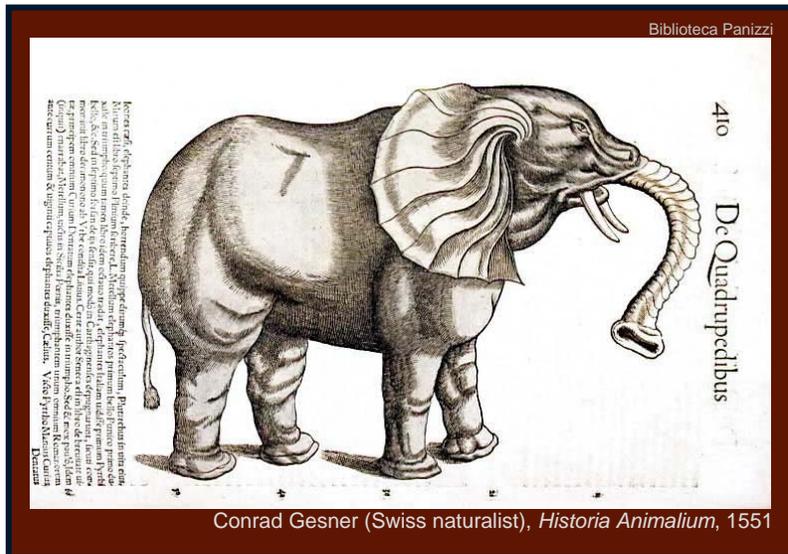
The *prone Posture of the Body* in the *Quadrupeds* is not only most beneficial to themselves but also most advantageous to *Man*. They perform their own Actions the better for that Posture, and they serve *Man* the better, both for *Carriage* and for *Tillage*. But then it's observable how exactly their *Legs* are made conformable to this Posture. It invites yet more Observation how admirably their *Legs* and *Feet* suit the Exercises of every Animal. [Mather reviews the legs and feet of quadrupeds including the elephant, deer, hare, otter, mole, beaver, bat, etc. He proceeds to similar reviews of quadrupeds' bones, heads, and internal organs.]

The *Sagacity* of some *Quadrupeds*, though so far short of *Man's* yet is a matter of Astonishment to *Man*; and *Man's* will be short of *theirs*, if it see not the *glorious GOD of Nature operating in it*. . . .

The Words of the excellent Sir *Richard Blackmore*, in his essay on *the Immortality of the Soul*, are worthy to be transcribed ad pondered on this Occasion. “. . . this is certain, the *Souls of Brutes* are not design'd by the Great Creator for such a Life of *Pleasure* and *Happiness* as that of *Human Souls* in a State of *Immortality* and *Perfection*, . . .

And then the Liberty give us to *butcher* our useful Creatures at our pleasure; 'tis observed by Mr. [Thomas] *Robinson* that this will be found a *Kindness* rather than a *Cruelty* to the Creatures. If we kill them for our *Food*, their Dispatch is quick and much less dolorous than that they should be torn to pieces by such cruel Masters as the *Lion* and the *Tiger* and *Bear*, who would not five them time to *die*, bur even eat their *Flesh* from their *Bones alive*; . . .

It is very certain our Dominion over the Creatures is very much impair'd by our Fall from God. Those Creatures do now either *fly from* us, or *fly at* us, which, if we had been faithful to our God, would not have done so. . . .



Conrad Gesner (Swiss naturalist), *Historia Animalium*, 1551

ESSAY XXXII. *Of MAN.*_____

And now let the *Lord of this lower World* be introduced, MAN, who is to do the Part of a *Priest* for the rest of the Creation, and offer up to God the *Praises* which are owing from and for them all. . . .

The BODY of MAN, being *most obvious* to our view, is that which *we will first* begin with: a *Machine* of a most astonishing Workmanship and Contrivance! *My God, I will praise Thee, for I am strangely and wonderfully made!* . . .⁴¹

'Tis what calls for a deep Consideration with us, that in the *Body* of Man there is nothing deficient, nothing superfluous, an End and Use for everything. *Natura non abundat in superfluis, nec deficit in necessariis.*⁴² There is no Part that we can well spare, not any that can say to the rest, *I have no need of you!* . . .

The *Variety* of the *Parts* whereof the Body is composed cannot but oblige our Admiration, cannot but compel our admiring Souls to acknowledge our glorious Maker!

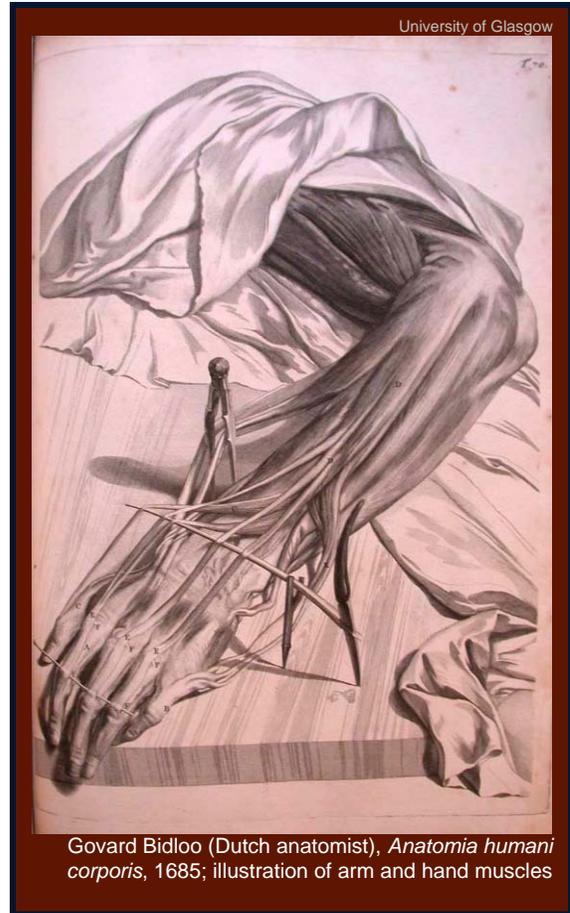
The *Bones* in a Skeleton are two hundred and forty-five, besides the *Ossa Sesamoidæa*,⁴³ which are forty-eight. The *Muscles* of the Body are four hundred and forty-six. The *Nerves* which come immediately out of the Skull, from the *Medulla oblongata*, are ten Pair. The *Nerves* which come out between the *Vertebræ* are thirty Pair. . . . [Mather proceeds with detailed summaries of the sensory and internal organs, nervous system, skeletal and muscular structures, etc. of the human body.]

. . . Who can behold a Machine composed of so many Parts, to the right Form and Order and Motion whereof there are such an infinite number of Intentions required, without crying out, *Who can be compared to the Lord!* . . .⁴⁴

. . . The SOUL, which has mustered the many *Thoughts* wherewith our *Christian Philosopher* has fill'd his Pages, must now be thought upon. But oh! How much is the *Father of Spirits*⁴⁵ to be herewith acknowledged and glorified! . . .

REASON, what is it but a *Faculty* formed by GOD in the Mind of Man, enabling him to discern certain *Maxims of Truth* which God himself has established and to make true Inferences from them! In all the Dictates of *Reason*, there is *the Voice of God*. Whenever any *reasonable thing* is offered, I have GOD speaking to me. . . .

The Union between the SOUL and the BODY is altogether inexplicable, the *Soul* not having any *Surface* to touch the *Body*, and the *Body* not having any *Sentiment* as the *Soul*. The *Union* of the *Soul* and *Body* does consist, as Monsieur [Daniel] *Tauvry* expresses it, in the *Conformity* of our *Thoughts* to our *Corporeal* Actions; *but*, says he, *for the Explication of this Conformity, we must have recourse to a superior Power*. Truly, *Sirs*, do what you can, you must quickly come to *that!* . . .



⁴¹ Adapted from Psalms 139:14.

⁴² "Nature does not abound in superfluities, nor does she lack the necessities." Aristotle had formulated the maxim, "Nature does nothing in vain" (*De partibus animalium* 4.11.691b).

⁴³ That is, sesamoid bones, or certain small bones and cartilages found in tendinous structures. [Solberg footnote continues.]

⁴⁴ Psalms 89:6.

⁴⁵ Adapted from Hebrews 12:9.

It is likely that the Transition from *Human* to *perfect MIND* is made by a *gradual Ascent*. There may be *Angels* whose Faculties may be as much superior to ours, as ours may be to those of a *Snail* or a *Worm*. . . .

Atheism is now forever chased and hissed out of the World. Everything in the World concurs to a Sentence of *Banishment* upon it. *Fly, thou Monster, and hide, and let not the darkest Recesses of Africa itself be able to cherish thee; never dare to show thyself in a World where everything stands ready to overwhelm thee!* A BEING that must be *superior* to *Matter*, even the *Creator* and *Governor* of all *Matter*, is everywhere so conspicuous, that there can be nothing more *monstrous* than to *deny the God that is above*. . . .⁴⁶

Having dispatch'd the *Atheist* with bestowing on him *not many* Thoughts, yet *more* than could be deserved by such an *Idiot*; I will proceed now to propose two general Strokes of *Piety*, which will appear to a *Christian Philosopher* as unexceptionable as any Proposals that ever were made to him.

First, the Works of the glorious God exhibited to our View. 'Tis most certain they do *bespeak*, and they should *excite* our *Acknowledgments of His Glories* appearing in them. The Great GOD is infinitely *gratified* in beholding the Displays of His own infinite *Power* and *Wisdom* and *Goodness* in the Works which He has made; but it is also a most acceptable Gratification to Him, when such of His Works as are the *rational beholders* of themselves, and of the rest, shall with devout Minds *acknowledge* His Perfections which they see shining there. Never does one endued with *Reason* do anything more evidently *reasonable* than when he makes everything that occurs to him in the vast Fabric of the World an *Incentive* to some agreeable Efforts and Sallies of *Religion*. . . .

And then, secondly, the CHRIST of God must not be forgotten, who is *the Lord of all*. *I am not ashamed of the Gospel of CHRIST*,⁴⁷ of which I will *affirm constantly*,⁴⁸ that if the *Philosopher* do not call it in, he *paganizes*, and leaves the finest and brightest Part of his Work *unfinished*. . . .

O CHRISTIAN, *lift up now thine Eyes, and look from the place where thou art*⁴⁹ to all Points of the Compass, and concerning *whatever thou seest*,⁵⁰ allow that all these things were formed *for the Sake* of that Glorious-One, who is now *God manifest in the Flesh*⁵¹ of our JESUS. 'Tis on *His Account* that the eternal Godhead has the *Delight* in all these things which preserves them in their Being, and grants them the *Help* in the *obtaining* whereof they *continue to this day*.⁵²

Scientists cited by Mather in selections presented here:

B.C.	384	-	322	Aristotle	Greek
A.D.	23	-	79	Pliny the Elder	Roman
	1514	-	1574	George Joachim Rhæticus	German
	1571	-	1630	Johannes Kepler	German
	1596	-	1650	René Descartes	French
ca.	1600	-	1671	Adamus Olearius	Russian [Adam Oelschläger]
	1616	-	1703	John Wallis	English
	1625	-	1712	Gian-Domenico Cassini	Italian
	1627	-	1691	Robert Boyle	English
	1629	-	1695	Christiaan Huygens	Dutch
	1635	-	1702	Robert Hooke	English
	1639	-	1713	Thomas Tompion	English [watchmaker]
	1642	-	1727	Isaac Newton	English
	1656	-	1698	William Molyneux	Irish
	1656?	-	1743	Edmond Halley	English
	1657	-	1735	William Derham	English
	1663	-	1728	Cotton Mather	American
	1669	-	1701	Daniel Tavvry	French
	1671	-	1743	George Cheyne	English
	1671	- ca.	1743	Pierre Hérigone	French

⁴⁶ Adapted from Job 31:28.

⁴⁷ Romans 1:16.

⁴⁸ Titus 3:8.

⁴⁹ Genesis 13:14.

⁵⁰ Adapted from Revelation 1:11.

⁵¹ Adapted from 1 Timothy 3:16.

⁵² Adapted from Acts 26:22.