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.”

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. . . .

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.
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. . . .

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

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! . . .

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

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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. . .

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.

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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*\(^\text{10}\) 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.\(^\text{11}\)

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<thead>
<tr>
<th>The Distance from the Sun in English Miles</th>
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Great GOD, thou hast lifted me up to Heaven: Oh! let me not be cast after all down to Hell. . . .\(^\text{12}\)

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 *Eccentrical 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.

\(^{12}\) 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 Blessings15 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 Dictator16 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. . . .

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 Vacuii [“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 Flame19 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 Muscovy\(^21\) 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, *Aquaee 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 spirtled\(^26\) into the circumambient Space, were it not kept well together by this wondrous Contrivate 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.

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. . . .

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\(^{27}\) 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, and the Lime-stone? How helpful the Warming-Stone? 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 remarkable, 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. . . .

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 ἔντομα and by Pliny therefore Insecta, because of their having certain Incisures and Indentings about their Bodies.

The French Philosopher 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, 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
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 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 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? How many Millions of the Fish are every Year fetch’d out of their Element and intern’d in the hungry Bowels of Men? . . .
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 *their*, 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*, but 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. . . .
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! . . .

'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. 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 Sesamoidea, 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! . . .

. . . 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 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] Tavvry 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! . . .

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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...

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 endowed 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, of which I will affirm constantly, 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 to all Points of the Compass, and concerning whatever thou seest, allow that all these things were formed for the Sake of that Glorious-One, who is now God manifest in the Flesh 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.