History of the Warfare of Science with Theology in Christendom

（Volume II）

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CHAPTER III. ASTRONOMY.

I. THE OLD SACRED THEORY OF THE UNIVERSE.

The next great series of battles was fought over the relations of the visible heavens to the earth.

In the early Church, in view of the doctrine so prominent in the New Testament, that the earth was soon to be destroyed, and that there were to be "new heavens and a new earth," astronomy, like other branches of science, was generally looked upon as futile. Why study the old heavens and the old earth, when they were so soon to be replaced with something infinitely better? This feeling appears in St. Augustine's famous utterance, "What concern is it to me whether the heavens as a sphere inclose the earth in the middle of the world or overhang it on either side?"

As to the heavenly bodies, theologians looked on them as at best only objects of pious speculation. Regarding their nature the fathers of the Church were divided. Origen, and

others with him, thought them living beings possessed of souls, and this belief was mainly based upon the scriptural vision of the morning stars. singing together, and upon the beautiful appeal to the "stars and light" in the song of the three children the Benedicite which the Anglican communion has so wisely retained in its Liturgy.

Other fathers thought the stars abiding places of the angels, and that stars were moved by angels. The Gnostics thought the stars spiritual beings governed by angels, and appointed not to cause earthly events but to indicate them.

As to the heavens in general, the prevailing view in the Church was based upon the scriptural declarations that a solid vault a "firmament" was extended above the earth, and that the heavenly bodies were simply lights hung within it. This was for a time held very tenaciously. St. Philastrius, in his famous treatise on heresies, pronounced it a heresy to deny that the stars are brought out by God from his treasure house and hung in the sky every evening; any other view he declared "false to the Catholic faith." This

view also survived in the sacred theory established so firmly by Cosmas in the sixth century. Having established his plan of the universe upon various texts in the Old and New Testaments, and having made it a vast oblong box, covered by the solid "firmament," he brought in additional texts from Scripture to account for the planetary movements, and developed at length the theory that the sun and planets are moved and the "windows of heaven" opened and shut by angels appointed for that purpose.

How intensely real this way of looking at the universe was, we find in the writings of St. Isidore, the greatest leader of orthodox thought in the seventh century. He affirms that since the fall of man, and on account of it, the sun and moon shine with a feebler light; but he proves from a text in Isaiah that when the world shall be fully redeemed these "great lights" will shine again in all their early splendour. But, despite these authorities and their theological finalities, the evolution of scientific thought continued, its main germ being the geocentric doctrine the

doctrine that the earth is the centre, and that the sun and planets revolve about it.

For passage cited from Clement of Alexandria, see English translation, Edinburgh, 1869, vol. ii, p. 368; also the Miscellanies, Book V, cap. vi. For typical statements by St. Augustine, see De Genesi, ii, cap. ix, in Migne, Patr. Lat., tome xxiv, pp. 270-271. For Origen's view, see the De Principiis, lib. i, cap. vii; see also Leopardi's Errori Populari, cap. xi; also Wilson's Selections from the Prophetic Scriptures in Ante Nicene Library, p. 132. For Philo Judaeus, see On the Creation of the World, chaps. xviii and xix, and On Monarchy, chap. i. For St. Isidore, see the De Ordine Creaturarum, cap v, in Migne, Patr. Lat., lxxxiii, pp. 923-925; also 1000, 1001. For Philastrius, see the De Hoeresibus, chap. cxxxiii, in Migne, tome xii, p. 1264. For Cosmas's view, see his Topographia Christiana, in Montfaucon, Col. Nov. Patrum, ii, p. 150, and elsewhere as cited in my chapter on Geography.

This doctrine was of the highest respectability: it had

been developed at a very early period, and had been elaborated until it accounted well for the apparent movements of the heavenly bodies; its final name, "Ptolemaic theory," carried weight; and, having thus come from antiquity into the Christian world, St. Clement of Alexandria demonstrated that the altar in the Jewish tabernacle was "a symbol of the earth placed in the middle of the universe": nothing more was needed; the geocentric theory was fully adopted by the Church and universally held to agree with the letter and spirit of Scripture.

As to the respectibility of the geocentric theory, etc., see Grote's Plato, vol. iii, p. 257; also Sir G. C. Lewis's Astronomy of the Ancients, chap. iii, sec. 1, for a very thoughtful statement of Plato's view, and differing from ancient statements. For plausible elaboration of it, and for supposed agreement of the Scripture with it, see Fromundus, Anti Aristarchus, Antwerp, 1631; also Melanchthon's Initia Doctrinae Physicae. For an admirable

statement of the theological view of the geocentric theory, antipodes, etc., see Eicken, Geschichte und System der mittelalterlichen Weltanschauung, pp. 618 et seq.

Wrought into this foundation, and based upon it, there was developed in the Middle Ages, mainly out of fragments of Chaldean and other early theories preserved in the Hebrew Scriptures, a new sacred system of astronomy, which became one of the great treasures of the universal Church the last word of revelation.

Three great men mainly reared this structure. First was the unknown who gave to the world the treatises ascribed to Dionysius the Areopagite. It was unhesitatingly believed that these were the work of St. Paul's Athenian convert, and therefore virtually of St. Paul himself. Though now known to be spurious, they were then considered a treasure of inspiration, and an emperor of the East sent them to an emperor of the West as the most worthy of gifts. In the ninth century they were widely circulated in western Europe, and became a fruitful source of thought, especially

on the whole celestial hierarchy. Thus the old ideas of astronomy were vastly developed, and the heavenly hosts were classed and named in accordance with indications scattered through the sacred Scriptures.

The next of these three great theologians was Peter Lombard, professor at the University of Paris. About the middle of the twelfth century he gave forth his collection of Sentences, or Statements by the Fathers, and this remained until the end of the Middle Ages the universal manual of theology. In it was especially developed the theological view of man's relation to the universe. The author tells the world: "Just as man is made for the sake of God that is, that he may serve Him, so the universe is made for the sake of man that is, that it may serve HIM; therefore is man placed at the middle point of the universe, that he may both serve and be served."

The vast significance of this view, and its power in resisting any real astronomical science, we shall see, especially in the time of Galileo.

The great triad of thinkers culminated in St. Thomas Aquinas the sainted theologian, the glory of the mediaeval Church, the "Angelic Doctor," the most marvellous intellect between Aristotle and Newton; he to whom it was believed that an image of the Crucified had spoken words praising his writings. Large of mind, strong, acute, yet just even more than just to his opponents, he gave forth, in the latter half of the thirteenth century, his Cyclopaedia of Theology, the Summa Theologica. In this he carried the sacred theory of the universe to its full development. With great power and clearness he brought the whole vast system, material and spiritual, into its relations to God and man.

For the beliefs of Chaldean astronomers in revolving spheres carrying sun, moon, and planets, in a solid firmament supporting the celestial waters, and in angels as giving motion to the planets, see Lenormant; also Lethaby, 13-21; also Schroeder, Jensen, Lukas, et al. For the contribution of the pseudo Dionysius to mediaeval

cosmology, see Dion. Areopagita, De Coelesti Hierarchia, vers. Joan. Scoti, in Migne, Patr. Lat., cxxii. For the contribution of Peter Lombard, see Pet. Lomb., Libr. Sent., II, i, 8, IV, i, 6, 7, in Migne, tome 192. For the citations from St. Thomas Aquinas, see the Summa, ed. Migne, especially Pars I, Qu. 70, (tome i, pp. 1174-1184); also Quaestio 47, Art. iii. For good general statement, see Milman, Latin Christianity, iv, 191 et seq.; and for relation of Cosmas to these theologians of western Europe, see Milman, as above, viii, 228, note.

Thus was the vast system developed by these three leaders of mediaeval thought; and now came the man who wrought it yet more deeply into European belief, the poet divinely inspired who made the system part of the world's LIFE. Pictured by Dante, the empyrean and the concentric heavens, paradise, purgatory, and hell, were seen of all men; the God Triune, seated on his throne upon the circle of the heavens, as real as the Pope seated in the chair of St. Peter; the seraphim, cherubim, and thrones, surrounding the

Almighty, as real as the cardinals surrounding the Pope; the three great orders of angels in heaven, as real as the three great orders, bishops, priests, and deacons, on earth; and the whole system of spheres, each revolving within the one above it, and all moving about the earth, subject to the primum mobile, as real as the feudal system of western Europe, subject to the Emperor.

For the central sun, hierarchy of angels, and concentric circles, see Dante, Paradiso, canto xxviii. For the words of St. Thomas Aquinas, showing to Virgil and Dante the great theologians of the Middle Ages, see canto x, and in Dean Plumptre's translation, vol. ii, pp. 56 et seq.; also Botta, Dante, pp. 350, 351. As to Dante's deep religious feeling and belief in his own divine mission, see J. R. Lowell, Among my Books, vol. i, p. 36. For a remarkable series of coloured engravings, showing Dante's whole cosmology, see La Materia della Divina Comedia di Dante dichiriata in vi tavole, da Michelangelo Caetani, published by the monks of Monte Cassino, to whose

kindness I am indebted for my copy.

Let us look into this vast creation the highest achievement of theology somewhat more closely.

Its first feature shows a development out of earlier theological ideas. The earth is no longer a flat plain inclosed by four walls and solidly vaulted above, as theologians of previous centuries had believed it, under the inspiration of Cosmas; it is no longer a mere flat disk, with sun, moon, and stars hung up to give it light, as the earlier cathedral sculptors had figured it; it has become a globe at the centre of the universe. Encompassing it are successive transparent spheres, rotated by angels about the earth, and each carrying one or more of the heavenly bodies with it: that nearest the earth carrying the moon; the next, Mercury; the next, Venus; the next, the Sun; the next three, Mars, Jupiter, and Saturn; the eighth carrying the fixed stars. The ninth was the primum mobile, and inclosing all was the tenth heaven the Empyrean. This was immovable the boundary between creation and the great outer void;

and here, in a light which no one can enter, the Triune God sat enthroned, the "music of the spheres" rising to Him as they moved. Thus was the old heathen doctrine of the spheres made Christian.

In attendance upon the Divine Majesty, thus enthroned, are vast hosts of angels, who are divided into three hierarchies, one serving in the empyrean, one in the heavens, between the empyrean and the earth, and one on the earth.

Each of these hierarchies is divided into three choirs, or orders; the first, into the orders of Seraphim, Cherubim, and Thrones; and the main occupation of these is to chant incessantly to "continually cry" the divine praises.

The order of Thrones conveys God’s will to the second hierarchy, which serves in the movable heavens. This second hierarchy is also made up of three orders. The first of these, the order of Dominions, receives the divine commands; the second, the order of Powers, moves the heavens, sun, moon, planets, and stars, opens and shuts the

"windows of heaven," and brings to pass all other celestial phenomena; the third, the order of Empire, guards the others.

The third and lowest hierarchy is also made up of three orders. First of these are the Principalities, the guardian spirits of nations and kingdoms. Next come Archangels; these protect religion, and bear the prayers of the saints to the foot of God's throne. Finally come Angels; these care for earthly affairs in general, one being appointed to each mortal, and others taking charge of the qualities of plants, metals, stones, and the like. Throughout the whole system, from the great Triune God to the lowest group of angels, we see at work the mystic power attached to the triangle and sacred number three the same which gave the triune idea to ancient Hindu theology, which developed the triune deities in Egypt, and which transmitted this theological gift to the Christian world, especially through the Egyptian Athanasius.

Below the earth is hell. This is tenanted by the angels

who rebelled under the lead of Lucifer, prince of the seraphim the former favourite of the Trinity; but, of these rebellious angels, some still rove among the planetary spheres, and give trouble to the good angels; others pervade the atmosphere about the earth, carrying lightning, storm, drought, and hail; others infest earthly society, tempting men to sin; but Peter Lombard and St. Thomas Aquinas take pains to show that the work of these devils is, after all, but to discipline man or to mete out deserved punishment.

All this vast scheme had been so riveted into the Ptolemaic view by the use of biblical texts and theological reasonings that the resultant system of the universe was considered impregnable and final. To attack it was blasphemy.

It stood for centuries. Great theological men of science, like Vincent of Beauvais and Cardinal d'Ailly, devoted themselves to showing not only that it was supported by Scripture, but that it supported Scripture. Thus was the geocentric theory embedded in the beliefs and aspirations,

in the hopes and fears, of Christendom down to the middle of the sixteenth century.

For the earlier cosmology of Cosmas, with citations from Montfaucon, see the chapter on Geography in this work. For the views of mediaeval theologians, see foregoing notes in this chapter. For the passages of Scripture on which the theological part of this structure was developed, see especially Romans viii, 38; Ephesians i, 21; Colossians i, 16 aand ii, 15; and innumerable passages in the Old Testament. As to the music of the spheres, see Dean Plumptre's Dante, vol. ii, p. 4, note. For an admirable summing up of the mediaeval cosmology in its relation to thought in general, see Rydberg, Magic of the Middle Ages, chap. i, whose summary I have followed in the main. For striking woodcuts showing the view taken of the successive heavens with their choirs of angels, the earth being at the centre with the spheres about it, and the Almighty on his throne above all, see the Neuremberg Chronicle, ff. iv and v; its date is 1493. For charts showing

the continuance of this general view down to the beginning of the sixteenth century, see the various editions of the Margarita Philosophica, from that of 1503 onward, astronomical part. For interesting statements regarding the Trinities of gods in ancient Egypt, see Sharpe, History of Egypt, vol. i, pp. 94 and 101. The present writer once heard a lecture in Cairo, from an eminent Scotch Doctor of Medicine, to account for the ancient Hindu and Egyptian sacred threes and trinities. The lecturer's theory was that, when Jehovah came down into the Garden of Eden and walked with Adam in "the cool of the day," he explained his triune character to Adam, and that from Adam it was spread abroad to the various ancient nations.

II. THE HELIOCENTRIC THEORY.

But, on the other hand, there had been planted, long before, the germs of a heliocentric theory. In the sixth century before our era, Pythagoras, and after him Philolaus, had suggested the movement of the earth and planets about

a central fire; and, three centuries later, Aristarchus had restated the main truth with striking precision. Here comes in a proof that the antagonism between theological and scientific methods is not confined to Christianity; for this statement brought upon Aristarchus the charge of blasphemy, and drew after it a cloud of prejudice which hid the truth for six hundred years. Not until the fifth century of our era did it timidly appear in the thoughts of Martianus Capella: then it was again lost to sight for a thousand years, until in the fifteenth century, distorted and imperfect, it appeared in the writings of Cardinal Nicholas de Cusa.

But in the shade cast by the vast system which had grown from the minds of the great theologians and from the heart of the great poet there had come to this truth neither bloom nor fruitage.

Quietly, however, the soil was receiving enrichment and the air warmth. The processes of mathematics were constantly improved, the heavenly bodies were steadily observed, and at length appeared, far from the centres of

thought, on the borders of Poland, a plain, simple minded scholar, who first fairly uttered to the modern world the truth now so commonplace, then so astounding that the sun and planets do not revolve about the earth, but that the earth and planets revolve about the sun: this man was Nicholas Copernicus.

Copernicus had been a professor at Rome, and even as early as 1500 had announced his doctrine there, but more in the way of a scientific curiosity or paradox, as it had been previously held by Cardinal de Cusa, than as the statement of a system representing a great fact in Nature. About thirty years later one of his disciples, Widmanstadt, had explained it to Clement VII; but it still remained a mere hypothesis, and soon, like so many others, disappeared from the public view. But to Copernicus, steadily studying the subject, it became more and more a reality, and as this truth grew within him he seemed to feel that at Rome he was no longer safe. To announce his discovery there as a theory or a paradox might amuse the papal court, but to announce it as

a truth as THE truth was a far different matter. He therefore returned to his little town in Poland.

To publish his thought as it had now developed was evidently dangerous even there, and for more than thirty years it lay slumbering in the mind of Copernicus and of the friends to whom he had privately intrusted it.

At last he prepared his great work on the Revolutions of the Heavenly Bodies, and dedicated it to the Pope himself. He next sought a place of publication. He dared not send it to Rome, for there were the rulers of the older Church ready to seize it; he dared not send it to Wittenberg, for there were the leaders of Protestantism no less hostile; he therefore intrusted it to Osiander, at Nuremberg.

For the germs of heliocentric theory planted long before, see Sir G. C. Lewis; and for a succinct statement of the claims of Pythagoras, Philolaus, Aristarchus, and Martianus Capella, see Hoefer, Hisoire de l'Astronomie, 1873, p. 107 et seq.; also Heller, Geschichte der Physik, Stuttgart, 1882, vol. i, pp. 12, 13; also pp. 99 et seq. For

germs among thinkers of India, see Whewell, vol. i, p. 277; also Whitney, Oriental and Linguistic Studies, New York, 1874; Essay on the Lunar Zodiac, p. 345. For the views of Vincent of Beauvais, see his Speculum Naturale, lib. xvi, cap. 21. For Cardinal d'Ailly's view, see his treatise De Concordia Astronomicae Veritatis cum Theologia (in his Ymago Mundi and separately). For general statement of De Cusa's work, see Draper, Intellectual Development of Europe, p. 512. For skilful use of De Cusa's view in order to mitigate censure upon the Church for its treatment of Copernicus's discovery, see an article in the Catholic World for January, 1869. For a very exact statement, in the spirit of judicial fairness, see Whewell, History of the Inductive Sciences, p. 275, and pp. 379, 380. In the latter, Whewell cites the exact words of De Cusa in the De Docta Ignorantia, and sums up in these words: "This train of thought might be a preparation for the reception of the Copernican system; but it is very different from the doctrine that the sun is the centre of the planetary system."

Whewell says: "De Cusa propounded the doctrine of the motion of the earth more as a paradox than as a reality. We can not consider this as any distinct anticipation of a profound and consistent view of the truth." On De Cusa, see also Heller, vol. i, p. 216. For Aristotle's views, and their elaboration by St. Thomas Aquinas, see the De Coelo et Mundo, sec. xx, and elsewhere in the latter. It is curious to see how even such a biographer as Archbishop Vaughan slurs over the angelic Doctor's errors. See Vaughan's Life and Labours of St. Thomas of Aquin, pp. 459, 460.

As to Copernicus's danger at Rome, the Catholic World for January, 1869, cites a speech of the Archbishop of Mechlin before the University of Louvain, to the effect that Copernicus defended his theory at Rome, in 1500, before two thousand scholars; also, that another professor taught the system in 1528, and was made apostolic notary by Clement VIII. All this, even if the doctrines taught were identical with Copernicus as finally developed which is simply not the case avails nothing against the

overwhelming testimony that Copernicus felt himself in danger testimony which the after history of the Copernican theory renders invincible. The very title of Fromundus's book, already cited, published within a few miles of the archbishop's own cathedral, and sanctioned expressly by the theological faculty of that same University of Louvain in 1630, utterly refutes the archbishop's idea that the Church was inclined to treat Copernicus kindly. The title is as follows: Ant Aristarchus sive Orbis Terrae Immobilis, in quo decretum S. Congregationis S. R. E. Cardinal. an. M.DC.XVI adversus Pythagorico Copernicanos editum defenditur, Antverpiae, MDCXXI. L'Epinois, Galilee, Paris, 1867, lays stress, p. 14, on the broaching of the doctrine by De Cusa in 1435, and by Widmanstadt in 1533, and their kind treatment by Eugenius IV and Clement VII; but this is absolutely worthless in denying the papal policy afterward. Lange, Geschichte des Materialismus, vol. i, pp. 217, 218, while admitting that De Cusa and Widmanstadt sustained

this theory and received honors from their respective popes, shows that, when the Church gave it serious consideration, it was condemned. There is nothing in this view unreasonable. It would be a parallel case to that of Leo X, at first inclined toward Luther and others, in their "squabbles with the envious friars," and afterward forced to oppose them. That Copernicus felt the danger, is evident, among other things, by the expression in the preface: "Statim me explodendum cum tali opinione clamitant." For dangers at Wittenberg, see Lange, as above, vol. i, p. 217.

But Osiander's courage failed him: he dared not launch the new thought boldly. He wrote a grovelling preface, endeavouring to excuse Copernicus for his novel idea, and in this he inserted the apologetic lie that Copernicus had propounded the doctrine of the earth's movement not as a fact, but as a hypothesis. He declared that it was lawful for an astronomer to indulge his imagination, and that this was what Copernicus had done.

Thus was the greatest and most ennobling, perhaps, of

scientific truths a truth not less ennobling to religion than to science forced, in coming before the world, to sneak and crawl.

Osiander, in a letter to Copernicus, dated April 20, 1541, had endeavored to reconcile him to such a procedure, and ends by saying, "Sic enim placidiores reddideris peripatheticos et theologos quos contradicturos metuis." See Apologia Tychonis in Kepler's Opera Omnia, Frisch's edition, vol. i, p. 246. Kepler holds Osiander entirely responsible for this preface. Bertrand, in his Fondateurs de l"astronomie moderne, gives its text, and thinks it possible that Copernicus may have yielded "in pure condescension toward his disciple." But this idea is utterly at variance with expressions in Copernicus's own dedicatory letter to the Pope, which follows the preface. For a good summary of the argument, see Figuier, Savants de la Renaissance, pp. 378, 379; see also citation from Gassendi's Life of Copernicus, in Flammarion, Vie de Copernic, p. 124. Mr. John Fiske, accurate as he usually is, in his Outlines of

Cosmic Philosophy appears to have followed Laplace, Delambre, and Petit into the error of supposing that Copernicus, and not Osiander, is responsible for the preface. For the latest proofs, see Menzer's translation of Copernicus's work, Thorn, 1879, notes on pp. 3 and 4 of the appendix.

On the 24th of May, 1543, the newly printed book arrived at the house of Copernicus. It was put into his hands; but he was on his deathbed. A few hours later he was beyond the reach of the conscientious men who would have blotted his reputation and perhaps have destroyed his life.

Yet not wholly beyond their reach. Even death could not be trusted to shield him. There seems to have been fear of vengeance upon his corpse, for on his tombstone was placed no record of his lifelong labours, no mention of his great discovery; but there was graven upon it simply a prayer: "I ask not the grace accorded to Paul; not that given to Peter; give me only the favour which Thou didst show to the thief on the cross."

Not till thirty years after did a friend dare write on his tombstone a memorial of his discovery.

See Flammarion, Vie de Copernic, p. 190.

The preface of Osiander, pretending that the book of Copernicus suggested a hypothesis instead of announcing a truth, served its purpose well. During nearly seventy years the Church authorities evidently thought it best not to stir the matter, and in some cases professors like Calganini were allowed to present the new view purely as a hypothesis. There were, indeed, mutterings from time to time on the theological side, but there was no great demonstration against the system until 1616. Then, when the Copernican doctrine was upheld by Galileo as a TRUTH, and proved to be a truth by his telescope, the book was taken in hand by the Roman curia. The statements of Copernicus were condemned, "until they should be corrected"; and the corrections required were simply such as would substitute for his conclusions the old Ptolemaic theory.

That this was their purpose was seen in that year when Galileo was forbidden to teach or discuss the Copernican theory, and when were forbidden "all books which affirm the motion of the earth." Henceforth to read the work of Copernicus was to risk damnation, and the world accepted the decree. The strongest minds were thus held fast. If they could not believe the old system, they must PRETEND that they believed it; and this, even after the great circumnavigation of the globe had done so much to open the eyes of the world! Very striking is the case of the eminent Jesuit missionary Joseph Acosta, whose great work on the Natural and Moral History of the Indies, published in the last quarter of the sixteenth century, exploded so many astronomical and geographical errors. Though at times curiously credulous, he told the truth as far as he dared; but as to the movement of the heavenly bodies he remained orthodox declaring, "I have seen the two poles, whereon the heavens turn as upon their axletrees."

The authorities deciding this matter in accordance

with the wishes of Pope V and Cardinal Bellarmine were the Congregation of the Index, or cardinals having charge of the Index Librorum Prohibitorum. Recent desperate attempts to fasten the responsibility on them as individuals seem ridiculous in view of the simple fact that their work was sanctioned by the highest Church authority, and required to be universally accepted by the Church. Eleven different editions of the Index in my own possession prove this. Nearly all of these declare on their title pages that they are issued by order of the pontiff of the period, and each is preface by a special papal bull or letter. See especially the Index of 1664, issued under order of Alexander VII, and that of 1761, under Benedict XIV. Copernicus's statements were prohibited in the Index "donec corrigantur." Kepler said that it ought to be worded "donec explicetur." See Bertand, Fondateurs de l'Astronomie moderne, p. 57. De Morgan, pp. 57 60, gives the corrections required by the Index of 1620. Their main aim seems to be to reduce Copernicus to the grovelling level of Osiander, making his

discovery a mere hypothesis; but occasionally they require a virtual giving up of the whole Copernican doctrine e.g., "correction" insisted upon for chap. viii, p. 6. For a scholarly account of the relation between Prohibitory and Expurgatory Indexes to each other, see Mendham, Literary Policy of the Church of Rome; also Reusch, Index der verbotenen Bucher, Bonn, 1855, vol. ii, chaps i and ii. For a brief but very careful statement, see Gebler, Galileo Galilei, English translation, London, 1879, chap. i; see also Addis and Arnold's Catholic Dictionary, article Galileo, p.8.

There was, indeed, in Europe one man who might have done much to check this current of unreason which was to sweep away so many thoughtful men on the one hand from scientific knowledge, and so many on the other from Christianity. This was Peter Apian. He was one of the great mathematical and astronomical scholars of the time. His brilliant abilities had made him the astronomical teacher of the Emperor Charles V. His work

on geography had brought him a world wide reputation; his work on astronomy brought him a patent of nobility; his improvements in mathematical processes and astronomical instruments brought him the praise of Kepler and a place in the history of science: never had a true man better opportunity to do a great deed. When Copernicus's work appeared, Apian was at the height of his reputation and power: a quiet, earnest plea from him, even if it had been only for ordinary fairness and a suspension of judgment, must have carried much weight. His devoted pupil, Charles V, who sat on the thrones of Germany and Spain, must at least have given a hearing to such a plea. But, unfortunately, Apian was a professor in an institution of learning under the strictest Church control the University of Ingolstadt. His foremost duty was to teach SAFE science to keep science within the line of scriptural truth as interpreted by theological professors. His great opportunity was lost. Apian continued to maunder over the Ptolemaic theory and astrology in his lecture room. The attack on the

Copernican theory he neither supported nor opposed; he was silent; and the cause of his silence should never be forgotten so long as any Church asserts its title to control university instruction.

For Joseph Acosta's statement, see the translation of his History, published by the Hakluyt Society, chap. ii. For Peter Apian, see Madler, Geschichte der Astronomie, Braunschweig, 1873, vol. i, p. 141. For evidences of the special favour of Charles V,see Delambre, Histoire de l'Astronomie au Moyen Age, p. 390; also Bruhns, in the Allgemeine deutsche Biographie. For an attempted apology for him, see Gunther, Peter and Philipp Apian, Prag, 1822, p. 62.

Doubtless many will exclaim against the Roman Catholic Church for this; but the simple truth is that Protestantism was no less zealous against the new scientific doctrine. All branches of the Protestant Church Lutheran, Calvinist, Anglican vied with each other in denouncing the Copernican doctrine as contrary to Scripture; and, at a later

period, the Puritans showed the same tendency.

Said Martin Luther: "People gave ear to an upstart astrologer who strove to show that the earth revolves, not the heavens or the firmament, the sun and the moon. Whoever wishes to appear clever must devise some new system, which of all systems is of course the very best. This fool wishes to reverse the entire science of astronomy; but sacred Scripture tells us that Joshua commanded the sun to stand still, and not the earth." Melanchthon, mild as he was, was not behind Luther in condemning Copernicus. In his treatise on the Elements of Physics, published six years after Copernicus's death, he says: "The eyes are witnesses that the heavens revolve in the space of twenty four hours. But certain men, either from the love of novelty, or to make a display of ingenuity, have concluded that the earth moves; and they maintain that neither the eighth sphere nor the sun revolves Now, it is a want of honesty and decency to assert such notions publicly, and the example is pernicious. It is the part of a good mind to accept the truth

as revealed by God and to acquiesce in it." Melanchthon then cites the passages in the Psalms and Ecclesiastes, which he declares assert positively and clearly that the earth stands fast and that the sun moves around it, and adds eight other proofs of his proposition that "the earth can be nowhere if not in the centre of the universe." So earnest does this mildest of the Reformers become, that he suggests severe measures to restrain such impious teachings as those of Copernicus.

See the Tischreden in the Walsch edition of Luther's Works, 1743, vol. xxii, p. 2260; also Melanchthon's Initia Doctrinae Physicae. This treatise is cited under a mistaken title by the Catholic World, September, 1870. The correct title is as given above; it will be found in the Corpus Reformatorum, vol. xiii (ed. Bretschneider, Halle, 1846), pp. 216, 217. See also Madler, vol. i, p. 176; also Lange, Geschichte des Materialismus, vol. i, p. 217; also Prowe, Ueber die Abhangigkeit des Copernicus, Thorn, 1865, p. 4; also note, pp. 5, 6, where text is given in full.

While Lutheranism was thus condemning the theory of the earth's movement, other branches of the Protestant Church did not remain behind. Calvin took the lead, in his Commentary on Genesis, by condemning all who asserted that the earth is not at the centre of the universe. He clinched the matter by the usual reference to the first verse of the ninety third Psalm, and asked, "Who will venture to place the authority of Copernicus above that of the Holy Spirit?" Turretin, Calvin's famous successor, even after Kepler and Newton had virtually completed the theory of Copernicus and Galileo, put forth his compendium of theology, in which he proved, from a multitude of scriptural texts, that the heavens, sun, and moon move about the earth, which stands still in the centre. In England we see similar theological efforts, even after they had become evidently futile. Hutchinson's Moses's Principia, Dr. Samuel Pike's Sacred Philosophy, the writings of Horne, Bishop Horsley, and President Forbes contain most earnest attacks upon the ideas of Newton, such attacks being based upon Scripture.

Dr. John Owen, so famous in the annals of Puritanism, declared the Copernican system a "delusive and arbitrary hypothesis, contrary to Scripture"; and even John Wesley declared the new ideas to "tend toward infidelity."

On the teachings on Protestantism as regards the Copernican theory, see citations in Canon Farrar's History of Interpretation, preface, xviii; also Rev. Dr. Shields, of Princeton, The Final Philosophy, pp. 60, 61.

And Protestant peoples were not a whit behind Catholic in following out such teachings. The people of Elbing made themselves merry over a farce in which Copernicus was the main object of ridicule. The people of Nuremberg, a Protestant stronghold, caused a medal to be struck with inscriptions ridiculing the philosopher and his theory.

Why the people at large took this view is easily understood when we note the attitude of the guardians of learning, both Catholic and Protestant, in that age. It throws great light upon sundry claims by modern theologians to

take charge of public instruction and of the evolution of science. So important was it thought to have "sound learning" guarded and "safe science" taught, that in many of the universities, as late as the end of the seventeenth century, professors were forced to take an oath not to hold the "Pythagorean" that is, the Copernican idea as to the movement of the heavenly bodies. As the contest went on, professors were forbidden to make known to students the facts revealed by the telescope. Special orders to this effect were issued by the ecclesiastical authorities to the universities and colleges of Pisa, Innspruck, Louvain, Douay, Salamanca, and others. During generations we find the authorities of these Universities boasting that these godless doctrines were kept away from their students. It is touching to hear such boasts made then, just as it is touching now to hear sundry excellent university authorities boast that they discourage the reading of Mill, Spencer, and Darwin. Nor were such attempts to keep the truth from students confined to the Roman

Catholic institutions of learning. Strange as it may seem, nowhere were the facts confirming the Copernican theory more carefully kept out of sight than at Wittenberg the university of Luther and Melanchthon. About the middle of the sixteenth century there were at that centre of Protestant instruction two astronomers of a very high order, Rheticus and Reinhold; both of these, after thorough study, had convinced themselves that the Copernican system was true, but neither of them was allowed to tell this truth to his students. Neither in his lecture announcements nor in his published works did Rheticus venture to make the new system known, and he at last gave up his professorship and left Wittenberg, that he might have freedom to seek and tell the truth. Reinhold was even more wretchedly humiliated. Convinced of the truth of the new theory, he was obliged to advocate the old; if he mentioned the Copernican ideas, he was compelled to overlay them with the Ptolemaic. Even this was not thought safe enough, and in 1571 the subject was intrusted to Peucer. He was eminently "sound," and

denounced the Copernican theory in his lectures as "absurd, and unfit to be introduced into the schools."

To clinch anti scientific ideas more firmly into German Protestant teaching, Rector Hensel wrote a text book for schools entitled The Restored Mosaic System of the World, which showed the Copernican astronomy to be unscriptural.

Doubtless this has a far off sound; yet its echo comes very near modern Protestantism in the expulsion of Dr. Woodrow by the Presbyterian authorities in South Carolina; the expulsion of Prof. Winchell by the Methodist Episcopal authorities in Tennessee; the expulsion of Prof. Toy by Baptist authorities in Kentucky; the expulsion of the professors at Beyrout under authority of American Protestant divines all for holding the doctrines of modern science, and in the last years of the nineteenth century.

For treatment of Copernican ideas by the people, see The Catholic World, as above; also Melanchthon, ubi supra; also Prowe, Copernicus, Berlin, 1883, vol. i, p. 269, note;

also pp. 279, 280; also Madler, i, p.167. For Rector Hensel, see Rev. Dr. Shield's Final Philosophy, p. 60. For details of recent Protestant efforts against evolution doctrines, see the chapter on the Fall of Man and Anthropology in this work.

But the new truth could not be concealed; it could neither be laughed down nor frowned down. Many minds had received it, but within the hearing of the papacy only one tongue appears to have dared to utter it clearly. This new warrior was that strange mortal, Giordano Bruno. He was hunted from land to land, until at last he turned on his pursuers with fearful invectives. For this he was entrapped at Venice, imprisoned during six years in the dungeons of the Inquisition at Rome, then burned alive, and his ashes scattered to the winds. Still, the new truth lived on.

Ten years after the martyrdom of Bruno the truth of Copernicus's doctrine was established by the telescope of Galileo.

For Bruno, see Bartholmess, Vie de Jordano Bruno, Paris, 1846, vol. i, p.121 and pp. 212 et seq.; also Berti,

Vita di Giordano Bruno, Firenze, 1868, chap. xvi; also Whewell, vol. i, pp. 272, 273. That Whewell is somewhat hasty in attributing Bruno's punishment entirely to the Spaccio della Bestia Trionfante will be evident, in spite of Montucla, to anyone who reads the account of the persecution in Bartholmess or Berti; and even if Whewell be right, the Spaccio would never have been written but for Bruno's indignation at ecclesiastical oppression. See Tiraboschi, vol. vii, pp. 466 et seq.

Herein was fulfilled one of the most touching of prophecies. Years before, the opponents of Copernicus had said to him, "If your doctrines were true, Venus would show phases like the moon." Copernicus answered: "You are right; I know not what to say; but God is good, and will in time find an answer to this objection." The God given answer came when, in 1611, the rude telescope of Galileo showed the phases of Venus.

For the relation of these discoveries to Copernicus's work, see Delambre, Histoire de l'Astronomie moderne,

discours preliminaire, p. xiv; also Laplace, Systeme du Monde, vol. i, p. 326; and for more careful statements, Kepler's Opera Omnia, edit. Frisch, tome ii, p. 464. For Copernicus's prophecy, see Cantu, Histoire Univerelle, vol. xv, p. 473. (Cantu was an eminent Roman Catholic.)

III. THE WAR UPON GALILEO.

On this new champion, Galileo, the whole war was at last concentrated. His discoveries had clearly taken the Copernican theory out of the list of hypotheses, and had placed it before the world as a truth. Against him, then, the war was long and bitter. The supporters of what was called "sound learning" declared his discoveries deceptions and his announcements blasphemy. Semi scientific professors, endeavouring to curry favour with the Church, attacked him with sham science; earnest preachers attacked him with perverted Scripture; theologians, inquisitors, congregations of cardinals, and at last two popes dealt with him, and, as was supposed, silenced his impious doctrine forever.

A very curious example of this sham science employed by theologians is seen in the argument, frequently used at that time, that, if the earth really moved, a stone falling from a height would fall back of a point immediately below its point of starting. This is used by Fromundus with great effect. It appears never to have occurred to him to test the matter by dropping a stone from the topmast of a ship. Bezenburg has mathematically demonstrated just such an abberation in falling bodies, as is mathematically required by the diurnal motion of the earth. See Jevons, Principles of Science, pp. 388, 389, second edition, 1877.

I shall present this warfare at some length because, so far as I can find, no careful summary of it has been given in our language, since the whole history was placed in a new light by the revelations of the trial documents in the Vatican Library, honestly published for the first time by L'Epinois in 1867, and since that by Gebler, Berti, Favaro, and others.

The first important attack on Galileo began in 1610, when he announced that his telescope had revealed the moons of the planet Jupiter. The enemy saw that this took the Copernican theory out of the realm of hypothesis, and they gave battle immediately. They denounced both his method and its results as absurd and impious. As to his method, professors bred in the "safe science" favoured by the Church argued that the divinely appointed way of arriving at the truth in astronomy was by theological reasoning on texts of Scripture; and, as to his results, they insisted, first, that Aristotle knew nothing of these new revelations; and, next, that the Bible showed by all applicable types that there could be only seven planets; that this was proved by the seven golden candlesticks of the Apocalypse, by the seven branched candlestick of the tabernacle, and by the seven churches of Asia; that from Galileo's doctrine consequences must logically result destructive to Christian truth. Bishops and priests therefore warned their flocks, and multitudes of the faithful besought

the Inquisition to deal speedily and sharply with the heretic.

See Delambre on the discovery of the satellites of Jupiter as the turning point with the heliocentric doctrine. As to its effects on Bacon, see Jevons, p. 638, as above. For argument drawn from the candlestick and the seven churches, see Delambre, p. 20.

In vain did Galileo try to prove the existence of satellites by showing them to the doubters through his telescope: they either declared it impious to look, or, if they did look, denounced the satellites as illusions from the devil. Good Father Clavius declared that "to see satellites of Jupiter, men had to make an instrument which would create them." In vain did Galileo try to save the great truths he had discovered by his letters to the Benedictine Castelli and the Grand Duchess Christine, in which he argued that literal biblical interpretation should not be applied to science; it was answered that such an argument only made his heresy more detestable; that he was "worse than Luther or Calvin."

The war on the Copernican theory, which up to that time had been carried on quietly, now flamed forth. It was declared that the doctrine was proved false by the standing still of the sun for Joshua, by the declarations that "the foundations of the earth are fixed so firm that they can not be moved," and that the sun "runneth about from one end of the heavens to the other."

For principle points as given, see Libri, Histoire des Sciences mathematiques en Italie, vol. iv, p. 211; De Morgan, Paradoxes, p. 26, for account of Father Clavius. It is interesting to know that Clavius, in his last years, acknowledged that "the whole system of the heavens is broken down, and must be mended," Cantu, Histoire Universelle, vol. xv, p. 478. See Th. Martin, Galilee, pp. 34, 208, and 266; also Heller, Geschichte der Physik, Stuttgart, 1882, vol. i, p. 366. For the original documents, see L'Epinois, pp.34 and 36; or better, Gebler's careful edition of the trial (Die Acten des Galileischen Processes, Stuttgart, 1877), pp. 47 et seq. Martin's translation seems somewhat

too free. See also Gebler, Galileo Galilei, English translation, London, 1879, pp. 76-78; also Reusch, Der Process Galilei's und die Jesuiten, Bonn, 1879, chaps. ix, x, xi.

But the little telescope of Galileo still swept the heavens, and another revelation was announced the mountains and valleys in the moon. This brought on another attack. It was declared that this, and the statement that the moon shines by light reflected from the sun, directly contradict the statement in Genesis that the moon is "a great light." To make the matter worse, a painter, placing the moon in a religious picture in its usual position beneath the feet of the Blessed Virgin, outlined on its surface mountains and valleys; this was denounced as a sacrilege logically resulting from the astronomer's heresy.

Still another struggle was aroused when the hated telescope revealed spots upon the sun, and their motion indicating the sun's rotation. Monsignor Elci, head of the University of Pisa, forbade the astronomer Castelli to

mention these spots to his students. Father Busaeus, at the University of Innspruck, forbade the astronomer Scheiner, who had also discovered the spots and proposed a SAFE explanation of them, to allow the new discovery to be known there. At the College of Douay and the University of Louvain this discovery was expressly placed under the ban, and this became the general rule among the Catholic universities and colleges of Europe. The Spanish universities were especially intolerant of this and similar ideas, and up to a recent period their presentation was strictly forbidden in the most important university of all that of Salamanca.

See Ticknor, History of Spanish Literature, vol. iii.

Such are the consequences of placing the instruction of men's minds in the hands of those mainly absorbed in saving men's souls. Nothing could be more in accordance with the idea recently put forth by sundry ecclesiastics, Catholic and Protestant, that the Church alone is empowered to promulgate scientific truth or direct

university instruction. But science gained a victory here also. Observations of the solar spots were reported not only from Galileo in Italy, but from Fabricius in Holland. Father Scheiner then endeavoured to make the usual compromise between theology and science. He promulgated a pseudo scientific theory, which only provoked derision.

The war became more and more bitter. The Dominican Father Caccini preached a sermon from the text, "Ye men of Galilee, why stand ye gazing up into heaven?" and this wretched pun upon the great astronomer's name ushered in sharper weapons; for, before Caccini ended, he insisted that "geometry is of the devil," and that "mathematicians should be banished as the authors of all heresies." The Church authorities gave Caccini promotion.

Father Lorini proved that Galileo's doctrine was not only heretical but "atheistic," and besought the Inquisition to intervene. The Bishop of Fiesole screamed in rage against the Copernican system, publicly insulted Galileo, and denounced him to the Grand Duke. The Archbishop of

Pisa secretly sought to entrap Galileo and deliver him to the Inquisition at Rome. The Archbishop of Florence solemnly condemned the new doctrines as unscriptural; and Paul V, while petting Galileo, and inviting him as the greatest astronomer of the world to visit Rome, was secretly moving the Archbishop of Pisa to pick up evidence against the astronomer.

But by far the most terrible champion who now appeared was Cardinal Bellarmin, one of the greatest theologians the world has known. He was earnest, sincere, and learned, but insisted on making science conform to Scripture. The weapons which men of Bellarmin's stamp used were purely theological. They held up before the world the dreadful consequences which must result to Christian theology were the heavenly bodies proved to revolve about the sun and not about the earth. Their most tremendous dogmatic engine was the statement that "his pretended discovery vitiates the whole Christian plan of salvation." Father Lecazre declared "it casts suspicion on

the doctrine of the incarnation." Others declared, "It upsets the whole basis of theology. If the earth is a planet, and only one among several planets, it can not be that any such great things have been done specially for it as the Christian doctrine teaches. If there are other planets, since God makes nothing in vain, they must be inhabited; but how can their inhabitants be descended from Adam? How can they trace back their origin to Noah's ark? How can they have been redeemed by the Saviour?" Nor was this argument confined to the theologians of the Roman Church; Melanchthon, Protestant as he was, had already used it in his attacks on Copernicus and his school.

In addition to this prodigious theological engine of war there was kept up a fire of smaller artillery in the shape of texts and scriptural extracts.

But the war grew still more bitter, and some weapons used in it are worth examining. They are very easily examined, for they are to be found on all the battlefields of science; but on that field they were used with more effect

than on almost any other. These weapons are the epithets "infidel" and "atheist." They have been used against almost every man who has ever done anything new for his fellow men. The list of those who have been denounced as "infidel" and "atheist" includes almost all great men of science, general scholars, inventors, and philanthropists.

The purest Christian life, the noblest Christian character, have not availed to shield combatants. Christians like Isaac Newton, Pascal, Locke, Milton, and even Fenelon and Howard, have had this weapon hurled against them. Of all proofs of the existence of a God, those of Descartes have been wrought most thoroughly into the minds of modern men; yet the Protestant theologians of Holland sought to bring him to torture and to death by the charge of atheism, and the Roman Catholic theologians of France thwarted him during his life and prevented any due honours to him after his death.

For various objectors and objections to Galileo by his contemporaries, see Libri, Histoire des Sciences

mathematiques en Italie, vol. iv, p. 233, 234; also Martin, Vie de Galilee. For Father Lecazre's argument, see Flammarion, Mondes imaginaires et mondes reels, 6th ed., pp. 315, 316. For Melanchthon's argument, see his Initia in Opera, vol. iii, Halle, 1846.

These epithets can hardly be classed with civilized weapons. They are burning arrows; they set fire to masses of popular prejudice, always obscuring the real question, sometimes destroying the attacking party. They are poisoned weapons. They pierce the hearts of loving women; they alienate dear children; they injure a man after life is ended, for they leave poisoned wounds in the hearts of those who loved him best fears for his eternal salvation, dread of the Divine wrath upon him. Of course, in these days these weapons, though often effective in vexing good men and in scaring good women, are somewhat blunted; indeed, they not infrequently injure the assailants more than the assailed. So it was not in the days of Galileo; they were then in all their sharpness and venom.

For curious exemplification of the way in which these weapons have been hurled, see lists of persons charged with "infidelity" and "atheism," in the Dictionnaire des Athees., Paris, (1800); also Lecky, History of Rationalism, vol. ii, p. 50. For the case of Descartes, see Saisset, Descartes et ses Precurseurs, pp. 103, 110. For the facility with which the term "atheist" has been applied from the early Aryans down to believers in evolution, see Tylor, Primitive Culture, vol. i, p. 420.

Yet a baser warfare was waged by the Archbishop of Pisa. This man, whose cathedral derives its most enduring fame from Galileo's deduction of a great natural law from the swinging lamp before its altar, was not an archbishop after the noble mould of Borromeo and Fenelon and Cheverus. Sadly enough for the Church and humanity, he was simply a zealot and intriguer: he perfected the plan for entrapping the great astronomer.

Galileo, after his discoveries had been denounced, had written to his friend Castelli and to the Grand Duchess

Christine two letters to show that his discoveries might be reconciled with Scripture. On a hint from the Inquisition at Rome, the archbishop sought to get hold of these letters and exhibit them as proofs that Galileo had uttered heretical views of theology and of Scripture, and thus to bring him into the clutch of the Inquisition. The archbishop begs Castelli, therefore, to let him see the original letter in the handwriting of Galileo. Castelli declines. The archbishop then, while, as is now revealed, writing constantly and bitterly to the Inquisition against Galileo, professes to Castelli the greatest admiration of Galileo's genius and a sincere desire to know more of his discoveries. This not succeeding, the archbishop at last throws off the mask and resorts to open attack.

The whole struggle to crush Galileo and to save him would be amusing were it not so fraught with evil. There were intrigues and counter intrigues, plots and counter plots, lying and spying; and in the thickest of this seething, squabbling, screaming mass of priests, bishops,

archbishops, and cardinals, appear two popes, Paul V and Urban VIII. It is most suggestive to see in this crisis of the Church, at the tomb of the prince of the apostles, on the eve of the greatest errors in Church policy the world has known, in all the intrigues and deliberations of these consecrated leaders of the Church, no more evidence of the guidance or presence of the Holy Spirit than in a caucus of New York politicians at Tammany Hall.

But the opposing powers were too strong. In 1615 Galileo was summoned before the Inquisition at Rome, and the mine which had been so long preparing was sprung. Sundry theologians of the Inquisition having been ordered to examine two propositions which had been extracted from Galileo's letters on the solar spots, solemnly considered these points during about a month and rendered their unanimous decision as follows: "THE FIRST PROPOSITION, THAT THE SUN IS THE CENTRE AND DOES NOT REVOLVE ABOUT THE EARTH, IS FOOLISH, ABSURD, FALSE IN THEOLOGY,

AND HERETICAL, BECAUSE EXPRESSLY CONTRARY TO HOLY SCRIPTURE"; AND "THE SECOND PROPOSITION, THAT THE EARTH IS NOT THE CENTRE BUT REVOLVES ABOUT THE SUN, IS ABSURD, FALSE IN PHILOSOPHY, AND, FROM A THEOLOGICAL POINT OF VIEW AT LEAST, OPPOSED TO THE TRUE FAITH."

The Pope himself, Paul V, now intervened again: he ordered that Galileo be brought before the Inquisition. Then the greatest man of science in that age was brought face to face with the greatest theologian Galileo was confronted by Bellarmin. Bellarmin shows Galileo the error of his opinion and orders him to renounce it. De Lauda, fortified by a letter from the Pope, gives orders that the astronomer be placed in the dungeons of the Inquisition should he refuse to yield. Bellarmin now commands Galileo, "in the name of His Holiness the Pope and the whole Congregation of the Holy Office, to relinquish altogether the opinion that the sun is the centre of the world and immovable, and that

the earth moves, nor henceforth to hold, teach, or defend it in any way whatsoever, verbally or in writing." This injunction Galileo acquiesces in and promises to obey.

I am aware that the theory proposed by Wohwill and developed by Gebler denied that this promise was ever made by Galileo, and holds that the passage was a forgery devised later by the Church rulers to justify the proceedings of 1632 and 1644. This would make the conduct of the Church worse, but authorities as eminent consider the charge not proved. A careful examination of the documents seems to disprove it.

This was on the 26th of February, 1616. About a fortnight later the Congregation of the Index, moved thereto, as the letters and documents now brought to light show, by Pope Paul V, solemnly rendered a decree that "THE DOCTRINE OF THE DOUBLE MOTION OF THE EARTH ABOUT ITS AXIS AND ABOUT THE SUN IS FALSE, AND ENTIRELY CONTRARY TO HOLY SCRIPTURE"; and that this opinion must neither be taught

nor advocated. The same decree condemned all writings of Copernicus and "ALL WRITINGS WHICH AFFIRM THE MOTION OF THE EARTH." The great work of Copernicus was interdicted until corrected in accordance with the views of the Inquisition; and the works of Galileo and Kepler, though not mentioned by name at that time, were included among those implicitly condemned as "affirming the motion of the earth."

The condemnations were inscribed upon the Index; and, finally, the papacy committed itself as an infallible judge and teacher to the world by prefixing to the Index the usual papal bull giving its monitions the most solemn papal sanction. To teach or even read the works denounced or passages condemned was to risk persecution in this world and damnation in the next. Science had apparently lost the decisive battle.

For a time after this judgment Galileo remained in Rome, apparently hoping to find some way out of this difficulty; but he soon discovered the hollowness of the

protestations made to him by ecclesiastics, and, being recalled to Florence, remained in his hermitage near the city in silence, working steadily, indeed, but not publishing anything save by private letters to friends in various parts of Europe.

But at last a better vista seemed to open for him. Cardinal Barberini, who had seemed liberal and friendly, became pope under the name of Urban VIII. Galileo at this conceived new hopes, and allowed his continued allegiance to the Copernican system to be known. New troubles ensued. Galileo was induced to visit Rome again, and Pope Urban tried to cajole him into silence, personally taking the trouble to show him his errors by argument. Other opponents were less considerate, for works appeared attacking his ideas works all the more unmanly, since their authors knew that Galileo was restrained by force from defending himself. Then, too, as if to accumulate proofs of the unfitness of the Church to take charge of advanced instruction, his salary as a professor at

the University of Pisa was taken from him, and sapping and mining began. Just as the Archbishop of Pisa some years before had tried to betray him with honeyed words to the Inquisition, so now Father Grassi tried it, and, after various attempts to draw him out by flattery, suddenly denounced his scientific ideas as "leading to a denial of the Real Presence in the Eucharist."

For the final assault upon him a park of heavy artillery was at last wheeled into place. It may be seen on all the scientific battlefields. It consists of general denunciation; and in 1631 Father Melchior Inchofer, of the Jesuits, brought his artillery to bear upon Galileo with this declaration: "The opinion of the earth's motion is of all heresies the most abominable, the most pernicious, the most scandalous; the immovability of the earth is thrice sacred; argument against the immortality of the soul, the existence of God, and the incarnation, should be tolerated sooner than an argument to prove that the earth moves." From the other end of Europe came a powerful

echo.

From the shadow of the Cathedral of Antwerp, the noted theologian Fromundus gave forth his famous treatise, the Ant Aristarclius. Its very title page was a contemptuous insult to the memory of Copernicus, since it paraded the assumption that the new truth was only an exploded theory of a pagan astronomer. Fromundus declares that "sacred Scripture fights against the Copernicans." To prove that the sun revolves about the earth, he cites the passage in the Psalms which speaks of the sun "which cometh forth as a bridegroom out of his chamber." To prove that the earth stands still, he quotes a passage from Ecclesiastes, "The earth standeth fast forever." To show the utter futility of the Copernican theory, he declares that, if it were true, "the wind would constantly blow from the east"; and that "buildings and the earth itself would fly off with such a rapid motion that men would have to be provided with claws like cats to enable them to hold fast to the earth's surface." Greatest weapon of all, he works up, by the use of

Aristotle and St. Thomas Aquinas, a demonstration from theology and science combined, that the earth MUST stand in the centre, and that the sun MUST revolve about it. Nor was it merely fanatics who opposed the truth revealed by Copernicus; such strong men as Jean Bodin, in France, and Sir Thomas Browne, in England, declared against it as evidently contrary to Holy Scripture.

For Father Inchofer's attack, see his Tractatus Syllepticus, cited in Galileo's letter to Deodati, July 28, 1634. For Fromundus's more famous attack, see his Ant Aristarchus, already cited, passim, but especially the heading of chap. vi, and the argument in chapters x and xi. A copy of this work may be found in the Astor Library at New York, and another in the White Library at Cornell University. For interesting references to one of Fromundus's arguments, showing, by a mixture of mathematics and theology, that the earth is the centre of the universe, see Quetelet, Histoire des Sciences mathematiques et physiques, Bruxelles, 1864, p. 170; also

Madler, Geschichte der Astronomie, vol. i, p. 274. For Bodin's opposition to the Copernican theory, see Hallam, Literature of Europe; also Lecky. For Sir Thomas Brown, see his Vulgar and Common Errors, book iv, chap. v; and as to the real reason for his disbelief in the Copernican view, see Dr. Johnson's preface to his Life of Browne, vol. i, p. xix, of his collected works.

IV. VICTORY OF THE CHURCH OVER GALILEO.

While news of triumphant attacks upon him and upon the truth he had established were coming in from all parts of Europe, Galileo prepared a careful treatise in the form of a dialogue, exhibiting the arguments for and against the Copernican and Ptolemaic systems, and offered to submit to any conditions that the Church tribunals might impose, if they would allow it to be printed. At last, after discussions which extended through eight years, they consented, imposing a humiliating condition a preface written in accordance with the ideas of Father Ricciardi, Master of

the Sacred Palace, and signed by Galileo, in which the Copernican theory was virtually exhibited as a play of the imagination, and not at all as opposed to the Ptolemaic doctrine reasserted in 1616 by the Inquisition under the direction of Pope Paul V.

This new work of Galileo the Dialogo appeared in 1632, and met with prodigious success. It put new weapons into the hands of the supporters of the Copernican theory. The pious preface was laughed at from one end of Europe to the other. This roused the enemy; the Jesuits, Dominicans, and the great majority of the clergy returned to the attack more violent than ever, and in the midst of them stood Pope Urban VIII, most bitter of all. His whole power was now thrown against Galileo. He was touched in two points: first, in his personal vanity, for Galileo had put the Pope's arguments into the mouth of one of the persons in the dialogue and their refutation into the mouth of another; but, above all, he was touched in his religious feelings. Again and again His Holiness insisted to all

comers on the absolute and specific declarations of Holy Scripture, which prove that the sun and heavenly bodies revolve about the earth, and declared that to gainsay them is simply to dispute revelation. Certainly, if one ecclesiastic more than another ever seemed NOT under the care of the Spirit of Truth, it was Urban VIII in all this matter.

Herein was one of the greatest pieces of ill fortune that has ever befallen the older Church. Had Pope Urban been broad minded and tolerant like Benedict XIV, or had he been taught moderation by adversity like Pius VII, or had he possessed the large scholarly qualities of Leo XIII, now reigning, the vast scandal of the Galileo case would never have burdened the Church: instead of devising endless quibbles and special pleadings to escape responsibility for this colossal blunder, its defenders could have claimed forever for the Church the glory of fearlessly initiating a great epoch in human thought.

But it was not so to be. Urban was not merely Pope; he was also a prince of the house of Barberini, and

therefore doubly angry that his arguments had been publicly controverted.

The opening strategy of Galileo's enemies was to forbid the sale of his work; but this was soon seen to be unavailing, for the first edition had already been spread throughout Europe. Urban now became more angry than ever, and both Galileo and his works were placed in the hands of the Inquisition. In vain did the good Benedictine Castelli urge that Galileo was entirely respectful to the Church; in vain did he insist that "nothing that can be done can now hinder the earth from revolving." He was dismissed in disgrace, and Galileo was forced to appear in the presence of the dread tribunal without defender or adviser. There, as was so long concealed, but as is now fully revealed, he was menaced with torture again and again by express order of Pope Urban, and, as is also thoroughly established from the trial documents themselves, forced to abjure under threats, and subjected to imprisonment by command of the Pope; the

Inquisition deferring in this whole matter to the papal authority. All the long series of attempts made in the supposed interest of the Church to mystify these transactions have at last failed. The world knows now that Galileo was subjected certainly to indignity, to imprisonment, and to threats equivalent to torture, and was at last forced to pronounce publicly and on his knees his recantation, as follows:

"I, Galileo, being in my seventieth year, being a prisoner and on my knees, and before your Eminences, having before my eyes the Holy Gospel, which I touch with my hands, abjure, curse, and detest the error and the heresy of the movement of the earth."

For various utterances of Pope Urban against the Copernican theory at this period, see extracts from the original documents given by Gebler. For punishment of those who had shown some favor to Galileo, see various citations, and especially those from the Vatican manuscript, Gebler, p. 216. As to the text of the abjuration, see

L'Epinois; also Polacco, Anticopernicus, etc., Venice, 1644; and for a discussion regarding its publication, see Favaro, Miscellanea Galileana, p. 804. It is not probable that torture in the ordinary sense was administered to Galileo, though it was threatened. See Th. Martin, Vie de Galilee, for a fair summing up of the case.

He was vanquished indeed, for he had been forced, in the face of all coming ages, to perjure himself. To complete his dishonour, he was obliged to swear that he would denounce to the Inquisition any other man of science whom he should discover to be supporting the "heresy of the motion of the earth."

Many have wondered at this abjuration, and on account of it have denied to Galileo the title of martyr. But let such gainsayers consider the circumstances. Here was an old man one who had reached the allotted threescore years and ten broken with disappointments, worn out with labours and cares, dragged from Florence to Rome, with the threat from the Pope himself that if he delayed he

should be "brought in chains"; sick in body and mind, given over to his oppressors by the Grand Duke who ought to have protected him, and on his arrival in Rome threatened with torture. What the Inquisition was he knew well. He could remember as but of yesterday the burning of Giordano Bruno in that same city for scientific and philosophic heresy; he could remember, too, that only eight years before this very time De Dominis, Archbishop of Spalatro, having been seized by the Inquisition for scientific and other heresies, had died in a dungeon, and that his body and his writings had been publicly burned.

To the end of his life nay, after his life was ended the persecution of Galileo was continued. He was kept in exile from his family, from his friends, from his noble employments, and was held rigidly to his promise not to speak of his theory. When, in the midst of intense bodily sufferings from disease, and mental sufferings from calamities in his family, he besought some little liberty, he was met with threats of committal to a dungeon. When, at

last, a special commission had reported to the ecclesiastical authorities that he had become blind and wasted with disease and sorrow, he was allowed a little more liberty, but that little was hampered by close surveillance. He was forced to bear contemptible attacks on himself and on his works in silence; to see the men who had befriended him severely punished; Father Castelli banished; Ricciardi, the Master of the Sacred Palace, and Ciampoli, the papal secretary, thrown out of their positions by Pope Urban, and the Inquisitor at Florence reprimanded for having given permission to print Galileo's work. He lived to see the truths he had established carefully weeded out from all the Church colleges and universities in Europe; and, when in a scientific work he happened to be spoken of as "renowned," the Inquisition ordered the substitution of the word "notorious."

For the substitution of the word "notorious" for "renowned" by order of the Inquisition, see Martin, p.227.

And now measures were taken to complete the

destruction of the Copernican theory, with Galileo's proofs of it. On the 16th of June, 1633, the Holy Congregation, with the permission of the reigning Pope, ordered the sentence upon Galileo, and his recantation, to be sent to all the papal nuncios throughout Europe, as well as to all archbishops, bishops, and inquisitors in Italy and this document gave orders that the sentence and abjuration be made known "to your vicars, that you and all professors of philosophy and mathematics may have knowledge of it, that they may know why we proceeded against the said Galileo, and recognise the gravity of his error, in order that they may avoid it, and thus not incur the penalties which they would have to suffer in case they fell into the same."

For a copy of this document, see Gebler, p. 269. As to the spread of this and similar documents notifying Europe of Galileo's condemnation, see Favaro, pp. 804, 805.

As a consequence, the processors of mathematics and astronomy in various universities of Europe were

assembled and these documents were read to them. To the theological authorities this gave great satisfaction. The Rector of the University of Douay, referring to the opinion of Galileo, wrote to the papal nuncio at Brussels: "The professors of our university are so opposed to this fanatical opinion that they have always held that it must be banished from the schools. In our English college at Douay this paradox has never been approved and never will be."

Still another step was taken: the Inquisitors were ordered, especially in Italy, not to permit the publication of a new edition of any of Galileo's works, or of any similar writings. On the other hand, theologians were urged, now that Copernicus and Galileo and Kepler were silenced, to reply to them with tongue and pen. Europe was flooded with these theological refutations of the Copernican system.

To make all complete, there was prefixed to the Index of the Church, forbidding "all writings which affirm the motion of the earth," a bull signed by the reigning Pope,

which, by virtue of his infallibility as a divinely guided teacher in matters of faith and morals, clinched this condemnation into the consciences of the whole Christian world.

From the mass of books which appeared under the auspices of the Church immediately after the condemnation of Galileo, for the purpose of rooting out every vestige of the hated Copernican theory from the mind of the world, two may be taken as typical. The first of these was a work by Scipio Chiaramonti, dedicated to Cardinal Barberini. Among his arguments against the double motion of the earth may be cited the following:

"Animals, which move, have limbs and muscles; the earth has no limbs or muscles, therefore it does not move. It is angels who make Saturn, Jupiter, the sun, etc., turn round. If the earth revolves, it must also have an angel in the centre to set it in motion; but only devils live there; it would therefore be a devil who would impart motion to the earth

"The planets, the sun, the fixed stars, all belong to one species namely, that of stars. It seems, therefore, to be a grievous wrong to place the earth, which is a sink of impurity, among these heavenly bodies, which are pure and divine things."

The next, which I select from the mass of similar works, is the Anticopernicus Catholicus of Polacco. It was intended to deal a finishing stroke at Galileo's heresy. In this it is declared:

"The Scripture always represents the earth as at rest, and the sun and moon as in motion; or, if these latter bodies are ever represented as at rest, Scripture represents this as the result of a great miracle

"These writings must be prohibited, because they teach certain principles about the position and motion of the terrestrial globe repugnant to Holy Scripture and to the Catholic interpretation of it, not as hypotheses but as established facts "

Speaking of Galileo's book, Polacco says that it

"smacked of Copernicanism," and that, "when this was shown to the Inquisition, Galileo was thrown into prison and was compelled to utterly abjure the baseness of this erroneous dogma."

As to the authority of the cardinals in their decree, Polacco asserts that, since they are the "Pope's Council" and his "brothers," their work is one, except that the Pope is favoured with special divine enlightenment.

Having shown that the authority of the Scriptures, of popes, and of cardinals is against the new astronomy, he gives a refutation based on physics. He asks: "If we concede the motion of the earth, why is it that an arrow shot into the air falls back to the same spot, while the earth and all things on it have in the meantime moved very rapidly toward the east? Who does not see that great confusion would result from this motion?"

Next he argues from metaphysics, as follows: "The Copernican theory of the earth's motion is against the nature of the earth itself, because the earth is not only cold

but contains in itself the principle of cold; but cold is opposed to motion, and even destroys it as is evident in animals, which become motionless when they become cold."

Finally, he clinches all with a piece of theological reasoning, as follows: "Since it can certainly be gathered from Scripture that the heavens move above the earth, and since a circular motion requires something immovable around which to move, the earth is at the centre of the universe."

For Chiaramonti's book and selections given, see Gebler as above, p. 271. For Polacco, see his work as cited, especially Assertiones i, ii, vii, xi, xiii, lxxiii, clcccvii, and others. The work is in the White Library at Cornell University. The date of it is 1644.

But any sketch of the warfare between theology and science in this field would be incomplete without some reference to the treatment of Galileo after his death. He had begged to be buried in his family tomb in Santa Croce; this

request was denied. His friends wished to erect a monument over him; this, too, was refused. Pope Urban said to the ambassador Niccolini that "it would be an evil example for the world if such honours were rendered to a man who had been brought before the Roman Inquisition for an opinion so false and erroneous; who had communicated it to many others, and who had given so great a scandal to Christendom." In accordance, therefore, with the wish of the Pope and the orders of the Inquisition, Galileo was buried ignobly, apart from his family, without fitting ceremony, without monument, without epitaph. Not until forty years after did Pierrozzi dare write an inscription to be placed above his bones; not until a hundred years after did Nelli dare transfer his remains to a suitable position in Santa Croce, and erect a monument above them. Even then the old conscientious hostility burst forth: the Inquisition was besought to prevent such honours to "a man condemned for notorious errors"; and that tribunal refused to allow any epitaph to be placed above him which had not

been submitted to its censorship. Nor has that old conscientious consistency in hatred yet fully relented: hardly a generation since has not seen some ecclesiastic, like Marini or De Bonald or Rallaye or De Gabriac, suppressing evidence, or torturing expressions, or inventing theories to blacken the memory of Galileo and save the reputation of the Church. Nay, more: there are school histories, widely used, which, in the supposed interest of the Church, misrepresent in the grossest manner all these transactions in which Galileo was concerned. Sancta simplicitas! The Church has no worse enemies than those who devise and teach these perversions. They are simply rooting out, in the long run, from the minds of the more thoughtful scholars, respect for the great organization which such writings are supposed to serve.

For the persecutions of Galileo's memory after his death, see Gebler and Wohwill, but especially Th. Martin, p. 243 and chaps. ix and x. For documentary proofs, see L'Epinois. For a collection of the slanderous theories

invented against Galileo, see Martin, final chapters and appendix. Both these authors are devoted to the Church, but unlike Monsignor Marini, are too upright to resort to the pious fraud of suppressing documents or interpolating pretended facts.

The Protestant Church was hardly less energetic against this new astronomy than the mother Church. The sacred science of the first Lutheran Reformers was transmitted as a precious legacy, and in the next century was made much of by Calovius. His great learning and determined orthodoxy gave him the Lutheran leadership. Utterly refusing to look at ascertained facts, he cited the turning back of the shadow upon King Hezekiah's dial and the standing still of the sun for Joshua, denied the movement of the earth, and denounced the whole new view as clearly opposed to Scripture. To this day his arguments are repeated by sundry orthodox leaders of American Lutheranism.

As to the other branches of the Reformed Church, we

have already seen how Calvinists, Anglicans, and, indeed, Protestant sectarians generally, opposed the new truth.

For Clovius, see Zoeckler, Geschichte, vol. i, pp. 684 and 763. For Calvin and Turretin, see Shields, The Final Philosophy, pp. 60, 61.

In England, among the strict churchmen, the great Dr. South denounced the Royal Society as "irreligious," and among the Puritans the eminent John Owen declared that Newton's discoveries were "built on fallible phenomena and advanced by many arbitrary presumptions against evident testimonies of Scripture." Even Milton seems to have hesitated between the two systems. At the beginning of the eighth book of Paradise Lost he makes Adam state the difficulties of the Ptolemaic system, and then brings forward an angel to make the usual orthodox answers. Later, Milton seems to lean toward the Copernican theory, for, referring to the earth, he says:

"Or she from west her silent course advance With inoffensive pace, that spinning sleeps On her soft axle,

while she faces even And bears thee soft with the smooth air along."

English orthodoxy continued to assert itself. In 1724 John Hutchinson, professor at Cambridge, published his Moses' Principia, a system of philosophy in which he sought to build up a complete physical system of the universe from the Bible. In this he assaulted the Newtonian theory as "atheistic," and led the way for similar attacks by such Church teachers as Horne, Duncan Forbes, and Jones of Nayland. But one far greater than these involved himself in this view. That same limitation of his reason by the simple statements of Scripture which led John Wesley to declare that, "unless witchcraft is true, nothing in the Bible is true," led him, while giving up the Ptolemaic theory and accepting in a general way the Copernican, to suspect the demonstrations of Newton. Happily, his inborn nobility of character lifted him above any bitterness or persecuting spirit, or any imposition of doctrinal tests which could prevent those who came after him from finding their way to

the truth.

But in the midst of this vast expanse of theologic error signs of right reason began to appear, both in England and America. Noteworthy is it that Cotton Mather, bitter as was his orthodoxy regarding witchcraft, accepted, in 1721, the modern astronomy fully, with all its consequences.

In the following year came an even more striking evidence that the new scientific ideas were making their way in England. In 1722 Thomas Burnet published the sixth edition of his Sacred Theory of the Earth. In this he argues, as usual, to establish the scriptural doctrine of the earth's stability; but in his preface he sounds a remarkable warning. He mentions the great mistake into which St. Augustine led the Church regarding the doctrine of the antipodes, and says, "If within a few years or in the next generation it should prove as certain and demonstrable that the earth is moved, as it is now that there are antipodes, those that have been zealous against it, and engaged the Scripture in the controversy, would have the

same reason to repent of their forwardness that St. Augustine would now, if he were still alive."

Fortunately, too, Protestantism had no such power to oppose the development of the Copernican ideas as the older Church had enjoyed. Yet there were some things in its warfare against science even more indefensible. In 1772 the famous English expedition for scientific discovery sailed from England under Captain Cook. Greatest by far of all the scientific authorities chosen to accompany it was Dr. Priestley. Sir Joseph Banks had especially invited him. But the clergy of Oxford and Cambridge interfered. Priestley was considered unsound in his views of the Trinity; it was evidently suspected that this might vitiate his astronomical observations; he was rejected, and the expedition crippled.

The orthodox view of astronomy lingered on in other branches of the Protestant Church. In Germany even Leibnitz attacked the Newtonian theory of gravitation on theological grounds, though he found some little consolation in thinking that it might be used to support the

Lutheran doctrine of consubstantiation.

In Holland the Calvinistic Church was at first strenuous against the whole new system, but we possess a comical proof that Calvinism even in its strongholds was powerless against it; for in 1642 Blaer published at Amsterdam his book on the use of globes, and, in order to be on the safe side, devoted one part of his work to the Ptolemaic and the other to the Copernican scheme, leaving the benevolent reader to take his choice.

For the attitude of Leibnetz, Hutchinson, and the others named toward the Newtonian theory, see Lecky, History of England in the Eighteenth Century, chap. ix. For John Wesley, see his Compendium of Natural Philosophy, being a Survey of the Wisdom of God in the Creation, London, 1784. See also Leslie Stephen, Eighteenth Century, vol. ii, p. 413. For Owen, see his Works, vol. xix, p. 310. For Cotton Mather's view, see The Christian Philosopher, London, 1721, especially pp. 16 and 17. For the case of Priestley, see Weld, History of the Royal Society, vol. ii, p.

56, for the facts and the admirable letter of Priestley upon this rejection. For Blaer, see his L'Usage des Globes, Amsterdam, 1642.

Nor have efforts to renew the battle in the Protestant Church been wanting in these latter days. The attempt in the Church of England, in 1864, to fetter science, which was brought to ridicule by Herschel, Bowring, and De Morgan; the assemblage of Lutheran clergy at Berlin, in 1868, to protest against "science falsely so called," are examples of these. Fortunately, to the latter came Pastor Knak, and his denunciations of the Copernican theory as absolutely incompatible with a belief in the Bible, dissolved the whole assemblage in ridicule.

In its recent dealings with modern astronomy the wisdom of the Catholic Church in the more civilized countries has prevented its yielding to some astounding errors into which one part of the Protestant Church has fallen heedlessly.

Though various leaders in the older Church have

committed the absurd error of allowing a text book and sundry review articles to appear which grossly misstate the Galileo episode, with the certainty of ultimately undermining confidence in her teachings among her more thoughtful young men, she has kept clear of the folly of continuing to tie her instruction, and the acceptance of our sacred books, to an adoption of the Ptolemaic theory.

Not so with American Lutheranism. In 1873 was published in St. Louis, at the publishing house of the Lutheran Synod of Missouri, a work entitled Astronomische Unterredung, the author being well known as a late president of a Lutheran Teachers' Seminary.

No attack on the whole modern system of astronomy could be more bitter. On the first page of the introduction the author, after stating the two theories, asks, "Which is right?" and says: "It would be very simple to me which is right, if it were only a question of human import. But the wise and truthful God has expressed himself on this matter in the Bible. The entire Holy Scripture settles the question

that the earth is the principal body (Hauptkorper) of the universe, that it stands fixed, and that sun and moon only serve to light it."

The author then goes on to show from Scripture the folly, not only of Copernicus and Newton, but of a long line of great astronomers in more recent times. He declares: "Let no one understand me as inquiring first where truth is to be found in the Bible or with the astronomers. No; I know that beforehand that my God never lies, never makes a mistake; out of his mouth comes only truth, when he speaks of the structure of the universe, of the earth, sun, moon, and stars

"Because the truth of the Holy Scripture is involved in this, therefore the above question is of the highest importance to me Scientists and others lean upon the miserable reed (Rohrstab) that God teaches only the order of salvation, but not the order of the universe."

Very noteworthy is the fact that this late survival of an ancient belief based upon text worship is found, not in the

teachings of any zealous priest of the mother Church, but in those of an eminent professor in that branch of Protestantism which claims special enlightenment.

For the amusing details of the attempt in the English Church to repress science, and of the way in which it was met, see De Morgan, Paradoxes, p. 42. For Pastor Knak and his associates, see the Revue des Deux Mondes, 1868. Of the recent Lutheran works against the Copernican astronomy, see especially Astronomische Unterredung zwischen einem Liebhaber der Astronomie und mehreren beruhmten Astronomer der Neuzeit, by J. C. W. L., St. Louis, 1873.

Nor has the warfare against the dead champions of science been carried on by the older Church alone.

On the 10th of May, 1859, Alexander von Humboldt was buried. His labours had been among the glories of the century, and his funeral was one of the most imposing that Berlin had ever seen. Among those who honoured themselves by their presence was the prince regent,

afterward the Emperor William I; but of the clergy it was observed that none were present save the officiating clergyman and a few regarded as unorthodox.

See Bruhns and Lassell, Life of Humboldt, London, 1873, vol. ii, p. 411.

V. RESULTS OF THE VICTORY OVER GALILEO.

We return now to the sequel of the Galileo case.

Having gained their victory over Galileo, living and dead, having used it to scare into submission the professors of astronomy throughout Europe, conscientious churchmen exulted. Loud was their rejoicing that the "heresy," the "infidelity" the "atheism" involved in believing that the earth revolves about its axis and moves around the sun had been crushed by the great tribunal of the Church, acting in strict obedience to the expressed will of one Pope and the written order of another. As we have seen, all books teaching this hated belief were put upon the Index of books forbidden to Christians, and that Index was prefaced by

a bull enforcing this condemnation upon the consciences of the faithful throughout the world, and signed by the reigning Pope.

The losses to the world during this complete triumph of theology were even more serious than at first appears: one must especially be mentioned. There was then in Europe one of the greatest thinkers ever given to mankind Rene Descartes. Mistaken though many of his reasonings were, they bore a rich fruitage of truth. He had already done a vast work. His theory of vortices assuming a uniform material regulated by physical laws as the beginning of the visible universe, though it was but a provisional hypothesis, had ended the whole old theory of the heavens with the vaulted firmament and the direction of the planetary movements by angels, which even Kepler had allowed. The scientific warriors had stirred new life in him, and he was working over and summing up in his mighty mind all the researches of his time. The result would have made an epoch in history. His aim was to combine all

knowledge and thought into a Treatise on the World, and in view of this he gave eleven years to the study of anatomy alone. But the fate of Galileo robbed him of all hope, of all courage; the battle seemed lost; he gave up his great plan forever.

For Descartes's discouragement, see Humboldt, Cosmos, London, 1851, vol iii, p. 21; also Lange, Geschichte des Materialismus, English translation, vol. i, pp. 248, 249, where the letters of Descartes are given, showing his despair, and the relinquishment of his best thoughts and works in order to preserve peace with the Church; also Saisset, Descartes et ses Precurseurs, pp. 100 et seq.; also Jolly, Histoire du Mouvement intellectuel au XVI Siecle, vol. i, p. 390.

But ere long it was seen that this triumph of the Church was in reality a prodigious defeat. From all sides came proofs that Copernicus and Galileo were right; and although Pope Urban and the inquisition held Galileo in strict seclusion, forbidding him even to SPEAK regarding

the double motion of the earth; and although this condemnation of "all books which affirm the motion of the earth" was kept on the Index; and although the papal bull still bound the Index and the condemnations in it on the consciences of the faithful; and although colleges and universities under Church control were compelled to teach the old doctrine it was seen by clear sighted men everywhere that this victory of the Church was a disaster to the victors.

New champions pressed on. Campanella, full of vagaries as he was, wrote his Apology for Galileo, though for that and other heresies, religious, and political, he seven times underwent torture.

And Kepler comes: he leads science on to greater victories. Copernicus, great as he was, could not disentangle scientific reasoning entirely from the theological bias: the doctrines of Aristotle and Thomas Aquinas as to the necessary superiority of the circle had vitiated the minor features of his system, and left breaches

in it through which the enemy was not slow to enter; but Kepler sees these errors, and by wonderful genius and vigour he gives to the world the three laws which bear his name, and this fortress of science is complete. He thinks and speaks as one inspired. His battle is severe. He is solemnly warned by the Protestant Consistory of Stuttgart "not to throw Christ's kingdom into confusion with his silly fancies," and as solemnly ordered to "bring his theory of the world into harmony with Scripture": he is sometimes abused, sometimes ridiculed, sometimes imprisoned. Protestants in Styria and Wurtemberg, Catholics in Austria and Bohemia, press upon him but Newton, Halley, Bradley, and other great astronomers follow, and to science remains the victory.

For Campanella, see Amabile, Fra Tommaso Campanella, Naples, 1882, especially vol. iii; also Libri, vol. iv, pp. 149 et seq. Fromundus, speaking of Kepler's explanation, says, "Vix teneo ebullientem risum." This is almost equal to the New York Church Journal, speaking of

John Stuart Mill as "that small sciolist," and of the preface to Dr. Draper's great work as "chippering." How a journal, generally so fair in its treatment of such subjects, can condescend to such weapons is one of the wonders of modern journalism. For the persecution of Kepler, see Heller, Geschichte der Physik, vol. i, pp. 281 et seq; also Reuschle, Kepler und die Astronomie, Frankfurt a. M., 1871, pp. 87 et seq. There is a poetic justice in the fact that these two last named books come from Wurtemberg professors. See also The New Englander for March, 1884, p. 178.

Yet this did not end the war. During the seventeenth century, in France, after all the splendid proofs added by Kepler, no one dared openly teach the Copernican theory, and Cassini, the great astronomer, never declared for it. In 1672 the Jesuit Father Riccioli declared that there were precisely forty nine arguments for the Copernican theory and seventy seven against it. Even after the beginning of the eighteenth century long after the demonstrations of Sir

Isaac Newton Bossuet, the great Bishop of Meaux, the foremost theologian that France has ever produced, declared it contrary to Scripture.

Nor did matters seem to improve rapidly during that century. In England, John Hutchinson, as we have seen, published in 1724 his Moses' Principia maintaining that the Hebrew Scriptures are a perfect system of natural philosophy, and are opposed to the Newtonian system of gravitation; and, as we have also seen, he was followed by a long list of noted men in the Church. In France, two eminent mathematicians published in 1748 an edition of Newton's Principia; but, in order to avert ecclesiastical censure, they felt obliged to prefix to it a statement absolutely false. Three years later, Boscovich, the great mathematician of the Jesuits, used these words: "As for me, full of respect for the Holy Scriptures and the decree of the Holy Inquisition, I regard the earth as immovable; nevertheless, for simplicity in explanation I will argue as if the earth moves; for it is proved that of the

two hypotheses the appearances favour this idea."

In Germany, especially in the Protestant part of it, the war was even more bitter, and it lasted through the first half of the eighteenth century. Eminent Lutheran doctors of divinity flooded the country with treatises to prove that the Copernican theory could not be reconciled with Scripture. In the theological seminaries and in many of the universities where clerical influence was strong they seemed to sweep all before them; and yet at the middle of the century we find some of the clearest headed of them aware of the fact that their cause was lost.

For Cassini's position, see Henri Martin, Histoire de France, vol. xiii, p. 175. For Riccioli, see Daunou, Etudes Historiques, vol. ii, p. 439. For Boussuet, see Bertrand, p. 41. For Hutchinson, see Lyell, Principles of Geology, p. 48. For Wesley, see his work, already cited. As to Boscovich, his declaration, mentioned in the text, was in 1746, but in 1785 he seemed to feel his position in view of history, and apologized abjectly; Bertrand, pp. 60, 61. See

also Whewell's notice of Le Sueur and Jacquier's introduction to their edition of Newton's Principia. For the struggle in Germany, see Zoeckler, Geschichte der Beziehungenzwischen Theologie und Naturwissenschaft, vol. ii, pp. 45 et seq.

In 1757 the most enlightened perhaps in the whole line of the popes, Benedict XIV, took up the matter, and the Congregation of the Index secretly allowed the ideas of Copernicus to be tolerated. Yet in 1765 Lalande, the great French astronomer, tried in vain at Rome to induce the authorities to remove Galileo's works from the Index. Even at a date far within our own nineteenth century the authorities of many universities in Catholic Europe, and especially those in Spain, excluded the Newtonian system. In 1771 the greatest of them all, the University of Salamanca, being urged to teach physical science, refused, making answer as follows: "Newton teaches nothing that would make a good logician or metaphysician; and Gassendi and Descartes do not agree so well with revealed

truth as Aristotle does."

Vengeance upon the dead also has continued far into our own century. On the 5th of May, 1829, a great multitude assembled at Warsaw to honour the memory of Copernicus and to unveil Thorwaldsen's statue of him.

Copernicus had lived a pious, Christian life; he had been beloved for unostentatious Christian charity; with his religious belief no fault had ever been found; he was a canon of the Church at Frauenberg, and over his grave had been written the most touching of Christian epitaphs. Naturally, then, the people expected a religious service; all was understood to be arranged for it; the procession marched to the church and waited. The hour passed, and no priest appeared; none could be induced to appear. Copernicus, gentle, charitable, pious, one of the noblest gifts of God to religion as well as to science, was evidently still under the ban. Five years after that, his book was still standing on the Index of books prohibited to Christians.

The edition of the Index published in 1819 was as

inexorable toward the works of Copernicus and Galileo as its predecessors had been; but in the year 182O came a crisis. Canon Settele, Professor of Astronomy at Rome, had written an elementary book in which the Copernican system was taken for granted. The Master of the Sacred Palace, Anfossi, as censor of the press, refused to allow the book to be printed unless Settele revised his work and treated the Copernican theory as merely a hypothesis. On this Settele appealed to Pope Pius VII, and the Pope referred the matter to the Congregation of the Holy Office. At last, on the 16th of August, 182O, it was decided that Settele might teach the Copernican system as established, and this decision was approved by the Pope. This aroused considerable discussion, but finally, on the 11th of September, 1822, the cardinals of the Holy Inquisition graciously agreed that "the printing and publication of works treating of the motion of the earth and the stability of the sun, in accordance with the general opinion of modern astronomers, is permitted at Rome." This decree

was ratified by Pius VII, but it was not until thirteen years later, in 1835, that there was issued an edition of the Index from which the condemnation of works defending the double motion of the earth was left out.

This was not a moment too soon, for, as if the previous proofs had not been sufficient, each of the motions of the earth was now absolutely demonstrated anew, so as to be recognised by the ordinary observer. The parallax of fixed stars, shown by Bessel as well as other noted astronomers in 1838, clinched forever the doctrine of the revolution of the earth around the sun, and in 1851 the great experiment of Foucault with the pendulum showed to the human eye the earth in motion around its own axis. To make the matter complete, this experiment was publicly made in one of the churches at Rome by the eminent astronomer, Father Secchi, of the Jesuits, in 1852 just two hundred and twenty years after the Jesuits had done so much to secure Galileo's condemnation.

For good statements of the final action of the Church

in the matter, see Gebler; also Zoeckler, ii, 352. See also Bertrand, Fondateurs de l'Astronomie moderne, p. 61; Flammarion, Vie de Copernic, chap. ix. As to the time when the decree of condemnation was repealed, there have been various pious attempts to make it earlier than the reality. Artaud, p. 307, cited in an apologetic article in the Dublin Review, September, 1865, says that Galileo's famous dialogue was published in 1714, at Padua, entire, and with the usual approbations. The same article also declares that in 1818, the ecclesiastical decrees were repealed by Pius VII in full Consistory. Whewell accepts this; but Cantu, an authority favourable to the Church, acknowledges that Copernicus's work remained on the Index as late as 1835 (Cantu, Histoire universelle, vol. xv, p. 483); and with this Th. Martin, not less favourable to the Church, but exceedingly careful as to the facts, agrees; and the most eminent authority of all, Prof. Reusch, of Bonn, in his Der Index der vorbotenen Bucher, Bonn, 1885, vol. ii, p. 396, confirms the above statement in the text. For a clear

statement of Bradley's exquisite demonstration of the Copernican theory by reasonings upon the rapidity of light, etc., and Foucault's exhibition of the rotation of the earth by the pendulum experiment, see Hoefer, Histoire de l'Astronomie, pp. 492 et seq. For more recent proofs of the Copernican theory, by the discoveries of Bunsen, Bischoff, Benzenberg, and others, see Jevons, Principles of Science.

VI. THE RETREAT OF THE CHURCH AFTER ITS VICTORY OVER GALILEO.

Any history of the victory of astronomical science over dogmatic theology would be incomplete without some account of the retreat made by the Church from all its former positions in the Galileo case.

The retreat of the Protestant theologians was not difficult. A little skilful warping of Scripture, a little skilful use of that time honoured phrase, attributed to Cardinal Baronius, that the Bible is given to teach us, not how the heavens go, but how men go to heaven, and a free use of

explosive rhetoric against the pursuing army of scientists, sufficed.

But in the older Church it was far less easy. The retreat of the sacro scientific army of Church apologists lasted through two centuries.

In spite of all that has been said by these apologists, there no longer remains the shadow of a doubt that the papal infallibility was committed fully and irrevocably against the double revolution of the earth. As the documents of Galileo's trial now published show, Paul V, in 1616, pushed on with all his might the condemnation of Galileo and of the works of Copernicus and of all others teaching the motion of the earth around its own axis and around the sun. So, too, in the condemnation of Galileo in 1633, and in all the proceedings which led up to it and which followed it, Urban VIII was the central figure. Without his sanction no action could have been taken.

True, the Pope did not formally sign the decree against the Copernican theory THEN; but this came later. In 1664

Alexander VII prefixed to the Index containing the condemnations of the works of Copernicus and Galileo and "all books which affirm the motion of the earth" a papal bull signed by himself, binding the contents of the Index upon the consciences of the faithful. This bull confirmed and approved in express terms, finally, decisively, and infallibly, the condemnation of "all books teaching the movement of the earth and the stability of the sun."

See Rev. William W. Roberts, The Pontifical Decrees against the Doctrine of the Earth's Movement, London, 1885, p. 94; and for the text of the papal bull, Speculatores domus Israel, pp. 132, 133, see also St. George Mivart's article in the Nineteenth Century for July, 1885. For the authentic publication of the bull, see preface to the Index of 1664, where the bull appears, signed by the Pope. The Rev. Mr. Roberts and Mr. St. George Mivart are Roman Catholics and both acknowledge that the papal sanction was fully given.

The position of the mother Church had been thus

made especially difficult; and the first important move in retreat by the apologists was the statement that Galileo was condemned, not because he affirmed the motion of the earth, but because he supported it from Scripture. There was a slight appearance of truth in this. Undoubtedly, Galileo's letters to Castelli and the grand duchess, in which he attempted to show that his astronomical doctrines were not opposed to Scripture, gave a new stir to religious bigotry. For a considerable time, then, this quibble served its purpose; even a hundred and fifty years after Galileo's condemnation it was renewed by the Protestant Mallet du Pan, in his wish to gain favour from the older Church.

But nothing can be more absurd, in the light of the original documents recently brought out of the Vatican archives, than to make this contention now. The letters of Galileo to Castelli and the Grand Duchess were not published until after the condemnation; and, although the Archbishop of Pisa had endeavoured to use them against him, they were but casually mentioned in 1616, and

entirely left out of view in 1633. What was condemned in 1616 by the Sacred Congregation held in the presence of Pope Paul V, as "ABSURD, FALSE IN THEOLOGY, AND HERETICAL, BECAUSE ABSOLUTELY CONTRARY TO HOLY SCRIPTURE," was the proposition that "THE SUN IS THE CENTRE ABOUT WHICH THE EARTH REVOLVES"; and what was condemned as "ABSURD, FALSE IN PHILOSOPHY, AND FROM A THEOLOGIC POINT OF VIEW, AT LEAST, OPPOSED TO THE TRUE FAITH," was the proposition that "THE EARTH IS NOT THE CENTRE OF THE UNIVERSE AND IMMOVABLE, BUT HAS A DIURNAL MOTION."

And again, what Galileo was made, by express order of Pope Urban, and by the action of the Inquisition under threat of torture, to abjure in 1633, was "THE ERROR AND HERESY OF THE MOVEMENT OF THE EARTH."

What the Index condemned under sanction of the bull

issued by Alexander VII in 1664 was, "ALL BOOKS TEACHING THE MOVEMENT OF THE EARTH AND THE STABILITY OF THE SUN."

What the Index, prefaced by papal bulls, infallibly binding its contents upon the consciences of the faithful, for nearly two hundred years steadily condemned was, "ALL BOOKS WHICH AFFIRM THE MOTION OF THE EARTH."

Not one of these condemnations was directed against Galileo "for reconciling his ideas with Scripture."

For the original trial documents, copied carefully from the Vatican manuscripts, see the Roman Catholic authority, L'Epinois, especially p. 35, where the principal document is given in its original Latin; see also Gebler, Die Acten des galilei'schen Processes, for still more complete copies of the same documents. For minute information regarding these documents and their publication, see Favaro, Miscellanea Galileana Inedita, forming vol. xxii, part iii, of the Memoirs of the Venetian Institute for 1887,

and especially pp. 891 and following.

Having been dislodged from this point, the Church apologists sought cover under the statement that Galileo was condemned not for heresy, but for contumacy and want of respect toward the Pope.

There was a slight chance, also, for this quibble: no doubt Urban VIII, one of the haughtiest of pontiffs, was induced by Galileo's enemies to think that he had been treated with some lack of proper etiquette: first, by Galileo's adhesion to his own doctrines after his condemnation in 1616; and, next, by his supposed reference in the Dialogue of 1632 to the arguments which the Pope had used against him.

But it would seem to be a very poor service rendered to the doctrine of papal infallibility to claim that a decision so immense in its consequences could be influenced by the personal resentment of the reigning pontiff.

Again, as to the first point, the very language of the various sentences shows the folly of this assertion; for these

sentences speak always of "heresy" and never of "contumacy." As to the last point, the display of the original documents settled that forever. They show Galileo from first to last as most submissive toward the Pope, and patient under the papal arguments and exactions. He had, indeed, expressed his anger at times against his traducers; but to hold this the cause of the judgment against him is to degrade the whole proceedings, and to convict Paul V, Urban VIII, Bellarmin, the other theologians, and the Inquisition, of direct falsehood, since they assigned entirely different reasons for their conduct. From this position, therefore, the assailants retreated.

The invention of the "contumacy" quibble seems due to Monsignor Marini, who appears also to have manipulated the original documents to prove it. Even Whewell was evidently somewhat misled by him, but Whewell wrote before L'Epinois had shown all the documents, and under the supposition that Marini was an honest man.

The next rally was made about the statement that the persecution of Galileo was the result of a quarrel between Aristotelian professors on one side and professors favouring the experimental method on the other. But this position was attacked and carried by a very simple statement. If the divine guidance of the Church is such that it can be dragged into a professorial squabble, and made the tool of a faction in bringing about a most disastrous condemnation of a proved truth, how did the Church at that time differ from any human organization sunk into decrepitude, managed nominally by simpletons, but really by schemers? If that argument be true, the condition of the Church was even worse than its enemies have declared it; and amid the jeers of an unfeeling world the apologists sought new shelter.

The next point at which a stand was made was the assertion that the condemnation of Galileo was "provisory"; but this proved a more treacherous shelter than the others. The wording of the decree of condemnation itself is a

sufficient answer to this claim. When doctrines have been solemnly declared, as those of Galileo were solemnly declared under sanction of the highest authority in the Church, "contrary to the sacred Scriptures," "opposed to the true faith," and "false and absurd in theology and philosophy" to say that such declarations are "provisory" is to say that the truth held by the Church is not immutable; from this, then, the apologists retreated.

This argument also seems to have been foisted upon the world by the wily Monsignor Marini.

Still another contention was made, in some respects more curious than any other: it was, mainly, that Galileo "was no more a victim of Catholics than of Protestants; for they more than the Catholic theologians impelled the Pope to the action taken."

See the Rev. A. M. Kirsch on Professor Huxley and Evolution, in The American Catholic Quarterly, October, 1877. The article is, as a whole, remarkably fair minded, and in the main, just, as to the Protestant attitude, and as to

the causes underlying the whole action against Galileo.

But if Protestantism could force the papal hand in a matter of this magnitude, involving vast questions of belief and far reaching questions of policy, what becomes of "inerrancy" of special protection and guidance of the papal authority in matters of faith?

While this retreat from position to position was going on, there was a constant discharge of small arms, in the shape of innuendoes, hints, and sophistries: every effort was made to blacken Galileo's private character: the irregularities of his early life were dragged forth, and stress was even laid upon breaches of etiquette; but this succeeded so poorly that even as far back as 1850 it was thought necessary to cover the retreat by some more careful strategy.

This new strategy is instructive. The original documents of the Galileo trial had been brought during the Napoleonic conquests to Paris; but in 1846 they were returned to Rome by the French Government, on the

express pledge by the papal authorities that they should be published. In 1850, after many delays on various pretexts, the long expected publication appeared. The personage charged with presenting them to the world was Monsignor Marini. This ecclesiastic was of a kind which has too often afflicted both the Church and the world at large. Despite the solemn promise of the papal court, the wily Marini became the instrument of the Roman authorities in evading the promise. By suppressing a document here, and interpolating a statement there, he managed to give plausible standing ground for nearly every important sophistry ever broached to save the infallibility of the Church and destroy the reputation of Galileo. He it was who supported the idea that Galileo was "condemned not for heresy, but for contumacy."

The first effect of Monsignor Marini's book seemed useful in covering the retreat of the Church apologists. Aided by him, such vigorous writers as Ward were able to throw up temporary intrenchments between the Roman

authorities and the indignation of the world.

But some time later came an investigator very different from Monsignor Marini. This was a Frenchman, M. L'Epinois. Like Marini, L'Epinois was devoted to the Church; but, unlike Marini, he could not lie. Having obtained access in 1867 to the Galileo documents at the Vatican, he published several of the most important, without suppression or pious fraudulent manipulation. This made all the intrenchments based upon Marini's statements untenable. Another retreat had to be made.

And now came the most desperate effort of all. The apologetic army, reviving an idea which the popes and the Church had spurned for centuries, declared that the popes AS POPES had never condemned the doctrines of Copernicus and Galileo; that they had condemned them as men simply; that therefore the Church had never been committed to them; that the condemnation was made by the cardinals of the inquisition and index; and that the Pope had evidently been restrained by interposition of

Providence from signing their condemnation. Nothing could show the desperation of the retreating party better than jugglery like this. The fact is, that in the official account of the condemnation by Bellarmin, in 1616, he declares distinctly that he makes this condemnation "in the name of His Holiness the Pope."

See the citation from the Vatican manuscript given in Gebler, p. 78.

Again, from Pope Urban downward, among the Church authorities of the seventeenth century the decision was always acknowledged to be made by the Pope and the Church. Urban VIII spoke of that of 1616 as made by Pope Paul V and the Church, and of that of 1633 as made by himself and the Church. Pope Alexander VII in 1664, in his bull Speculatores, solemnly sanctioned the condemnation of all books affirming the earth's movement.

For references by Urban VIII to the condemnation as made by Pope Paul V see pp. 136, 144, and elsewhere in Martin, who much against his will is forced to allow this.

See also Roberts, Pontifical decrees against the Earth's Movement, and St. George Mivart's article, as above quoted; also Reusch, Index der verbotenen Bucher, Bonn, 1885, vol. ii, pp. 29 et seq.

When Gassendi attempted to raise the point that the decision against Copernicus and Galileo was not sanctioned by the Church as such, an eminent theological authority, Father Lecazre, rector of the College of Dijon, publicly contradicted him, and declared that it "was not certain cardinals, but the supreme authority of the Church," that had condemned Galileo; and to this statement the Pope and other Church authorities gave consent either openly or by silence. When Descartes and others attempted to raise the same point, they were treated with contempt. Father Castelli, who had devoted himself to Galileo, and knew to his cost just what the condemnation meant and who made it, takes it for granted, in his letter to the papal authorities, that it was made by the Church. Cardinal Querenghi, in his letters; the ambassador Guicciardini, in his dispatches;

Polacco, in his refutation; the historian Viviani, in his biography of Galileo all writing under Church inspection and approval at the time, took the view that the Pope and the Church condemned Galileo, and this was never denied at Rome. The Inquisition itself, backed by the greatest theologian of the time (Bellarmin), took the same view. Not only does he declare that he makes the condemnation "in the name of His Holiness the Pope," but we have the Roman Index, containing the condemnation for nearly two hundred years, prefaced by a solemn bull of the reigning Pope binding this condemnation on the consciences of the whole Church, and declaring year after year that "all books which affirm the motion of the earth" are damnable. To attempt to face all this, added to the fact that Galileo was required to abjure "the heresy of the movement of the earth" by written order of the Pope, was soon seen to be impossible. Against the assertion that the Pope was not responsible we have all this mass of testimony, and the bull of Alexander VII in 1664.

For Lecazre's answer to Gassendi, see Martin, pp. 146, 147. For the attempt to make the crimes of Galileo breach of etiquette, see Dublin Review, as above. Whewell, vol. i, p. 283. Citation from Marini: "Galileo was punished for trifling with the authorities, to which he refused to submit, and was punished for obstinate contumacy, not heresy." The sufficient answer to all this is that the words of the inflexible sentence designating the condemned books are "libri omnes qui affirmant telluris motum." See Bertrand, p. 59. As to the idea that "Galileo was punished for not his opinion, but for basing it on Scripture," the answer may be found in the Roman Index of 1704, in which are noted for condemnation "Libri omnes docentes mobilitatem terrae et immobilitatem solis." For the way in which, when it was found convenient in argument, Church apologists insisted that it WAS "the Supreme Chief of the Church by a pontifical decree, and not certain cardinals," who condemned Galileo and his doctrine, see Father Lecazre's letter to Gassendi, in Flammarion, Pluralite

des Mondes, p. 427, and Urban VIII's own declarations as given by Martin. For the way in which, when necessary, Church apologists asserted the very contrary of this, declaring that it was issued in a doctrinal degree of the Congregation of the Index, and NOT as the Holy Father's teaching," see Dublin Review, September, 1865.

This contention, then, was at last utterly given up by honest Catholics themselves. In 1870 a Roman Catholic clergy man in England, the Rev. Mr. Roberts, evidently thinking that the time had come to tell the truth, published a book entitled The Pontifical Decrees against the Earth's Movement, and in this exhibited the incontrovertible evidences that the papacy had committed itself and its infallibility fully against the movement of the earth. This Catholic clergyman showed from the original record that Pope Paul V, in 1616, had presided over the tribunal condemning the doctrine of the earth's movement, and ordering Galileo to give up the opinion. He showed that Pope Urban VIII, in 1633, pressed on, directed, and

promulgated the final condemnation, making himself in all these ways responsible for it. And, finally, he showed that Pope Alexander VII, in 1664, by his bull Speculatores domus Israel attached to the Index, condemning "all books which affirm the motion of the earth," had absolutely pledged the papal infallibility against the earth's movement. He also confessed that under the rules laid down by the highest authorities in the Church, and especially by Sixtus V and Pius IX, there was no escape from this conclusion.

Various theologians attempted to evade the force of the argument. Some, like Dr. Ward and Bouix, took refuge in verbal niceties; some, like Dr. Jeremiah Murphy, comforted themselves with declamation. The only result was, that in 1885 came another edition of the Rev. Mr. Roberts's work, even more cogent than the first; and, besides this, an essay by that eminent Catholic, St. George Mivart, acknowledging the Rev. Mr. Roberts's position to be impregnable, and declaring virtually that the Almighty allowed Pope and Church to fall into complete

error regarding the Copernican theory, in order to teach them that science lies outside their province, and that the true priesthood of scientific truth rests with scientific investigators alone.

For the crushing answer by two eminent Roman Catholics to the sophistries cited an answer which does infinitely more credit to the older Church that all the perverted ingenuity used in concealing the truth or breaking the force of it see Roberts and St. George Mivart, as already cited.

In spite, then, of all casuistry and special pleading, this sturdy honesty ended the controversy among Catholics themselves, so far as fair minded men are concerned.

In recalling it at this day there stand out from its later phases two efforts at compromise especially instructive, as showing the embarrassment of militant theology in the nineteenth century.

The first of these was made by John Henry Newman in the days when he was hovering between the Anglican

and Roman Churches. In one of his sermons before the University of Oxford he spoke as follows:

"Scripture says that the sun moves and the earth is stationary, and science that the earth moves and the sun is comparatively at rest. How can we determine which of these opposite statements is the very truth till we know what motion is? If our idea of motion is but an accidental result of our present senses, neither proposition is true and both are true: neither true philosophically; both true for certain practical purposes in the system in which they are respectively found."

In all anti theological literature there is no utterance more hopelessly skeptical. And for what were the youth of Oxford led into such bottomless depths of disbelief as to any real existence of truth or any real foundation for it? Simply to save an outworn system of interpretation into which the gifted preacher happened to be born.

The other utterance was suggested by De Bonald and developed in the Dublin Review, as is understood, by one

of Newman's associates. This argument was nothing less than an attempt to retreat under the charge of deception against the Almighty himself. It is as follows: "But it may well be doubted whether the Church did retard the progress of scientific truth. What retarded it was the circumstance that God has thought fit to express many texts of Scripture in words which have every appearance of denying the earth's motion. But it is God who did this, not the Church; and, moreover, since he saw fit so to act as to retard the progress of scientific truth, it would be little to her discredit, even if it were true, that she had followed his example."

This argument, like Mr. Gosse's famous attempt to reconcile geology to Genesis by supposing that for some inscrutable purpose God deliberately deceived the thinking world by giving to the earth all the appearances of development through long periods of time, while really creating it in six days, each of an evening and a morning seems only to have awakened the amazed pity of thinking men. This, like the argument of Newman, was a

last desperate effort of Anglican and Roman divines to save something from the wreckage of dogmatic theology.

For the quotation from Newman, see his Sermons on the Theory of Religious Belief, sermon xiv, cited by Bishop Goodwin in Contemporary Review for January, 1892. For the attempt to take the blame off the shoulders of both Pope and cardinals and place it upon the Almighty, see the article above cited, in the Dublin Review, September 1865, p. 419 and July, 1871, pp. 157 et seq. For a good summary of the various attempts, and for replies to them in a spirit of judicial fairness, see Th. Martin, Vie de Galilee, though there is some special pleading to save the infallibility of the Pope and Church. The bibliography at the close is very valuable. For details of Mr. Gosse's theory, as developed in his Omphalos, see the chapter on Geology in this work. As to a still later attempt, see Wegg Prosser, Galileo and his Judges, London, 1889, the main thing in it being an attempt to establish, against the honest and honourable concessions of Catholics like Roberts and Mivart, sundry

far fetched and wire drawn distinctions between dogmatic and disciplinary bulls an attempt which will only deepen the distrust of straightforward reasoners. The author's point of view is stated in the words, "I have maintained that the Church has a right to lay her restraining hand on the speculations of natural science" (p. 167).

All these well meaning defenders of the faith but wrought into the hearts of great numbers of thinking men the idea that there is a necessary antagonism between science and religion. Like the landsman who lashes himself to the anchor of the sinking ship, they simply attached Christianity by the strongest cords of logic which they could spin to these mistaken ideas in science, and, could they have had their way, the advance of knowledge would have ingulfed both together.

On the other hand, what had science done for religion? Simply this: Copernicus, escaping persecution only by death; Giordano Bruno, burned alive as a monster of impiety; Galileo, imprisoned and humiliated as the worst of

misbelievers; Kepler, accused of "throwing Christ's kingdom into confusion with his silly fancies"; Newton, bitterly attacked for "dethroning Providence," gave to religion stronger foundations and more ennobling conceptions.

Under the old system, that princely astronomer, Alphonso of Castile, seeing the inadequacy of the Ptolemaic theory, yet knowing no other, startled Europe with the blasphemy that, if he had been present at creation, he could have suggested a better order of the heavenly bodies. Under the new system, Kepler, filled with a religious spirit, exclaimed, "I do think the thoughts of God." The difference in religious spirit between these two men marks the conquest made in this long struggle by Science for Religion.

As a pendant to this ejaculation of Kepler may be cited the words of Linnaeus: "Deum ominpotentem a tergo transeuntem vidi et obstupui."

Nothing is more unjust than to cast especial blame for

all this resistance to science upon the Roman Church. The Protestant Church, though rarely able to be so severe, has been more blameworthy. The persecution of Galileo and his compeers by the older Church was mainly at the beginning of the seventeenth century; the persecution of Robertson Smith, and Winchell, and Woodrow, and Toy, and the young professors at Beyrout, by various Protestant authorities, was near the end of the nineteenth century. Those earlier persecutions by Catholicism were strictly in accordance with principles held at that time by all religionists, Catholic and Protestant, throughout the world; these later persecutions by Protestants were in defiance of principles which all Protestants to day hold or pretend to hold, and none make louder claim to hold them than the very sects which persecuted these eminent Christian men of our day, men whose crime was that they were intelligent enough to accept the science of their time, and honest enough to acknowledge it.

Most unjustly, then, would Protestantism taunt

Catholicism for excluding knowledge of astronomical truths from European Catholic universities in the seventeenth and eighteenth centuries, while real knowledge of geological and biological and anthropological truth is denied or pitifully diluted in so many American Protestant colleges and universities in the nineteenth century.

Nor has Protestantism the right to point with scorn to the Catholic Index, and to lay stress on the fact that nearly every really important book in the last three centuries has been forbidden by it, so long as young men in so many American Protestant universities and colleges are nursed with "ecclesiastical pap" rather than with real thought, and directed to the works of "solemnly constituted impostors," or to sundry "approved courses of reading," while they are studiously kept aloof from such leaders in modern thought as Darwin, Spencer, Huxley, Draper, and Lecky.

It may indeed be justly claimed by Protestantism that some of the former strongholds of her bigotry have become liberalized; but, on the other hand, Catholicism can point to

the fact that Pope Leo XIII, now happily reigning, has made a noble change as regards open dealing with documents. The days of Monsignor Marini, it may be hoped, are gone. The Vatican Library, with its masses of historical material, has been thrown open to Protestant and Catholic scholars alike, and this privilege has been freely used by men representing all shades of religious thought.

As to the older errors, the whole civilized world was at fault, Protestant as well as Catholic. It was not the fault of religion; it was the fault of that short sighted linking of theological dogmas to scriptural texts which, in utter defiance of the words and works of the Blessed Founder of Christianity, narrow minded, loud voiced men are ever prone to substitute for religion. Justly is it said by one of the most eminent among contemporary Anglican divines, that "it is because they have mistaken the dawn for a conflagration that theologians have so often been foes of light."

For an exceedingly striking statement, by a Roman Catholic historian of genius, as to the POPULAR demand for persecution and the pressure of the lower strata in ecclesiastical organizations for cruel measures, see Balmes's Le Protestantisme compare au Catholicisme, etc., fourth edition, Paris, 1855, vol. ii. Archbishop Spaulding has something of the same sort in his Miscellanies. L'Epinois, Galilee, p. 22 et seq., stretches this as far as possible to save the reputation of the Church in the Galileo matter. As to the various branches of the Protestant Church in England and the United States, it is a matter of notoriety that the smug, well to do laymen, whether elders, deacons, or vestrymen, are, as a rule, far more prone to heresy hunting than are their better educated pastors. As to the cases of Messrs. Winchell, Woodrow, Toy, and all the professors at Beyrout, with details, see the chapter in this series on The Fall of Man and Anthropology. Among Protestant historians who have recently been allowed full and free examination of the treasures in the Vatican Library,

and even those involving questions between Catholicism and Protestantism, are von Sybel, of Berlin, and Philip Schaff, of New York. It should be added that the latter went with commendatory letters from eminent prelates in the Catholic Church in America and Europe. For the closing citation, see Canon Farrar, History of Interpretation, p. 432.

CHAPTER IV. FROM "SIGNS AND WONDERS" TO LAW IN THE HEAVENS.

I. THE THEOLOGICAL VIEW

Few things in the evolution of astronomy are more suggestive than the struggle between the theological and the scientific doctrine regarding comets the passage from the conception of them as fire balls flung by an angry God for the purpose of scaring a wicked world, to a recognition of them as natural in origin and obedient to law in movement. Hardly anything throws a more vivid light upon

the danger of wresting texts of Scripture to preserve ideas which observation and thought have superseded, and upon the folly of arraying ecclesiastical power against scientific discovery.

The present study, after its appearance in the Popular Science Monthly as a "new chapter in the Warfare of Science," was revised and enlarged to nearly its present form, and read before the American Historical Association, among whose papers it was published, in 1887, under the title of A History of the Doctrine of Comets.

Out of the ancient world had come a mass of beliefs regarding comets, meteors, and eclipses; all these were held to be signs displayed from heaven for the warning of mankind. Stars and meteors were generally thought to presage happy events, especially the births of gods, heroes, and great men. So firmly rooted was this idea that we constantly find among the ancient nations traditions of lights in the heavens preceding the birth of persons of note. The sacred books of India show that the births of Crishna

and of Buddha were announced by such heavenly lights. The sacred books of China tell of similar appearances at the births of Yu, the founder of the first dynasty, and of the inspired sage, Lao tse. According to the Jewish legends, a star appeared at the birth of Moses, and was seen by the Magi of Egypt, who informed the king; and when Abraham was born an unusual star appeared in the east. The Greeks and Romans cherished similar traditions. A heavenly light accompanied the birth of Aesculapius, and the births of various Caesars were heralded in like manner.

For Crishna, see Cox, Aryan Mythology, vol. ii, p. 133; the Vishnu Purana (Wilson's translation), book v, chap. iv. As to lights at the birth, or rather at the conception, of Buddha, see Bunsen, Angel Messiah, pp. 22, 23; Alabaster, Wheel of the Law (illustrations of Buddhism), p. 102; Edwin Arnold, Light of Asia; Bp. Bigandet, Life of Gaudama, the Burmese Buddha, p. 30; Oldenberg, Buddha (English translation), part i, chap. ii.

For Chinese legends regarding stars at the birth of Yu

and Lao tse, see Thornton, History of China, vol. i, p. 137; also Pingre, Cometographie, p. 245. Regarding stars at the birth of Moses and Abraham, see Calmet, Fragments, part viii; Baring Gould, Legends of Old Testament Characters, chap. xxiv; Farrar, Life of Christ, chap. iii. As to the Magi, see Higgins, Anacalypsis; Hooykaas, Ort, and Kuenen, Bible for Learners, vol. iii. For Greek and Roman traditions, see Bell, Pantheon, s. v. Aesculapius and Atreus; Gibbon, Decline and Fall, vol. i, pp. 151, 590; Farrar, Life of Christ (American edition), p. 52; Cox, Tales of Ancient Greece, pp. 41, 61, 62; Higgins, Anacalypsis, vol. i, p. 322; also Suetonius, Caes., Julius, p.88, Claud., p. 463; Seneca, Nat. Quaest, vol. 1, p. 1; Virgil, Ecl., vol. ix, p. 47; as well as Ovid, Pliny, and others.

The same conception entered into our Christian sacred books. Of all the legends which grew in such luxuriance and beauty about the cradle of Jesus of Nazareth, none appeals more directly to the highest poetic feeling than that given by one of the evangelists, in which a star, rising in

the east, conducted the wise men to the manger where the Galilean peasant child the Hope of Mankind, the Light of the World was lying in poverty and helplessness. Among the Mohammedans we have a curious example of the same tendency toward a kindly interpretation of stars and meteors, in the belief of certain Mohammedan teachers that meteoric showers are caused by good angels hurling missiles to drive evil angels out of the sky.

Eclipses were regarded in a very different light, being supposed to express the distress of Nature at earthly calamities. The Greeks believed that darkness overshadowed the earth at the deaths of Prometheus, Atreus, Hercules, Aesculapius, and Alexander the Great. The Roman legends held that at the death of Romulus there was darkness for six hours. In the history of the Caesars occur portents of all three kinds; for at the death of Julius the earth was shrouded in darkness, the birth of Augustus was heralded by a star, and the downfall of Nero by a comet. So, too, in one of the Christian legends clustering about

the crucifixion, darkness overspread the earth from the sixth to the ninth hour. Neither the silence regarding it of the only evangelist who claims to have been present, nor the fact that observers like Seneca and Pliny, who, though they carefully described much less striking occurrences of the same sort and in more remote regions, failed to note any such darkness even in Judea, have availed to shake faith in an account so true to the highest poetic instincts of humanity.

This view of the relations between Nature and man continued among both Jews and Christians. According to Jewish tradition, darkness overspread the earth for three days when the books of the Law were profaned by translation into Greek. Tertullian thought an eclipse an evidence of God's wrath against unbelievers. Nor has this mode of thinking ceased in modern times. A similar claim was made at the execution of Charles I; and Increase Mather thought an eclipse in Massachusetts an evidence of the grief of Nature at the death of President Chauncey, of

Harvard College. Archbishop Sandys expected eclipses to be the final tokens of woe at the destruction of the world, and traces of this feeling have come down to our own time.

The quaint story of the Connecticut statesman who, when his associates in the General Assembly were alarmed by an eclipse of the sun, and thought it the beginning of the Day of Judgment, quietly ordered in candles, that he might in any case be found doing his duty, marks probably the last noteworthy appearance of the old belief in any civilized nation.

For Hindu theories, see Alabaster, Wheel of the Law, 11. For Greek and Roman legends, See Higgins, Anacalypsis, vol. i, pp. 616, 617.; also Suetonius, Caes., Julius, p. 88, Claud., p. 46; Seneca, Quaest. Nat., vol. i, p. 1, vol. vii, p. 17; Pliny, Hist. Nat., vol. ii, p. 25; Tacitus, Ann., vol. xiv, p. 22; Josephus, Antiq., vol. xiv, p. 12; and the authorities above cited. For the tradition of the Jews regarding the darkness of three days, see citation in Renan, Histoire du Peuple Israel, vol. iv, chap. iv. For Tertullian's

belief regarding the significance of an eclipse, see the Ad Scapulum, chap. iii, in Migne, Patrolog. Lat., vol. i, p. 701. For the claim regarding Charles I, see a sermon preached before Charles II, cited by Lecky, England in the Eighteenth Century, vol. i, p. 65. Mather thought, too, that it might have something to do with the death of sundry civil functionaries of the colonies; see his Discourse concerning comets, 1682. For Archbishop Sandy's belief, see his eighteenth sermon (in Parker Soc. Publications). The story of Abraham Davenport has been made familiar by the poem of Whittier.

In these beliefs regarding meteors and eclipses there was little calculated to do harm by arousing that superstitious terror which is the worst breeding bed of cruelty. Far otherwise was it with the belief regarding comets. During many centuries it gave rise to the direst superstition and fanaticism. The Chaldeans alone among the ancient peoples generally regarded comets without fear, and thought them bodies wandering as harmless as

fishes in the sea; the Pythagoreans alone among philosophers seem to have had a vague idea of them as bodies returning at fixed periods of time; and in all antiquity, so far as is known, one man alone, Seneca, had the scientific instinct and prophetic inspiration to give this idea definite shape, and to declare that the time would come when comets would be found to move in accordance with natural law. Here and there a few strong men rose above the prevailing superstition. The Emperor Vespasian tried to laugh it down, and insisted that a certain comet in his time could not betoken his death, because it was hairy, and he bald; but such scoffing produced little permanent effect, and the prophecy of Seneca was soon forgotten. These and similar isolated utterances could not stand against the mass of opinion which upheld the doctrine that comets are "signs and wonders."

For terror caused in Rome by comets, see Pingre, Cometographie, pp. 165, 166. For the Chaldeans, see Wolf, Geschichte der Astronomie, p. 10 et seq., and p.

181 et seq.; also Pingre, chap. ii. For the Pythagorean notions, see citations from Plutarch in Costard, History of Astronomy, p. 283. For Seneca's prediction, see Guillemin, World of Comets (translated by Glaisher), pp. 4, 5; also Watson, On Comets, p. 126. For this feeling in antiquity generally, see the preliminary chapters of the two works last cited.

The belief that every comet is a ball of fire flung from the right hand of an angry God to warn the grovelling dwellers of earth was received into the early Church, transmitted through the Middle Ages to the Reformation period, and in its transmission was made all the more precious by supposed textual proofs from Scripture. The great fathers of the Church committed themselves unreservedly to it. In the third century Origen, perhaps the most influential of the earlier fathers of the universal Church in all questions between science and faith, insisted that comets indicate catastrophes and the downfall of empires and worlds. Bede, so justly revered by the

English Church, declared in the eighth century that "comets portend revolutions of kingdoms, pestilence, war, winds, or heat"; and John of Damascus, his eminent contemporary in the Eastern Church, took the same view. Rabanus Maurus, the great teacher of Europe in the ninth century, an authority throughout the Middle Ages, adopted Bede's opinion fully. St. Thomas Aquinas, the great light of the universal Church in the thirteenth century, whose works the Pope now reigning commends as the centre and source of all university instruction, accepted and handed down the same opinion. The sainted Albert the Great, the most noted genius of the medieval Church in natural science, received and developed this theory. These men and those who followed them founded upon scriptural texts and theological reasonings a system that for seventeen centuries defied every advance of thought.

For Origen, se his De Princip., vol. i, p. 7; also Maury, Leg. pieuses, p. 203, note. For Bede and others, see De Nat., vol. xxiv; Joh. Dam., De Fid. Or.,vol. ii, p. 7;

Maury, La Magie et l'Astronomie, pp. 181, 182. For Albertus Magnus, see his Opera, vol. i, tr. iii, chaps. x, xi. Among the texts of Scripture on which this belief rested was especially Joel ii, 30, 31.

The main evils thence arising were three: the paralysis of self help, the arousing of fanaticism, and the strengthening of ecclesiastical and political tyranny. The first two of these evils the paralysis of self help and the arousing of fanaticism are evident throughout all these ages. At the appearance of a comet we constantly see all Christendom, from pope to peasant, instead of striving to avert war by wise statesmanship, instead of striving to avert pestilence by observation and reason, instead of striving to avert famine by skilful economy, whining before fetiches, trying to bribe them to remove these signs of God's wrath, and planning to wreak this supposed wrath of God upon misbelievers.

As to the third of these evils the strengthening of ecclesiastical and civil despotism examples appear on

every side. It was natural that hierarchs and monarchs whose births were announced by stars, or whose deaths were announced by comets, should regard themselves as far above the common herd, and should be so regarded by mankind; passive obedience was thus strengthened, and the most monstrous assumptions of authority were considered simply as manifestations of the Divine will. Shakespeare makes Calphurnia say to Caesar:

"When beggars die, there are no comets seen; The heavens themselves blaze forth the death of princes."

Galeazzo, the tyrant of Milan, expressing satisfaction on his deathbed that his approaching end was of such importance as to be heralded by a comet, is but a type of many thus encouraged to prey upon mankind; and Charles V, one of the most powerful monarchs the world has known, abdicating under fear of the comet of 1556, taking refuge in the monastery of San Yuste, and giving up the best of his vast realms to such a scribbling bigot as Philip II, furnishes an example even more striking.

For Caesar, see Shakespeare, Julius Caesar, act ii, sc. 2. For Galeazzo, see Guillemin, World of Comets, p. 19. For Charles V, see Prof. Wolf's essay in the Monatschrift des wissenschaftlichen Vereins, Zurich, 1857, p. 228.

But for the retention of this belief there was a moral cause. Myriads of good men in the Christian Church down to a recent period saw in the appearance of comets not merely an exhibition of "signs in the heavens" foretold in Scripture, but also Divine warnings of vast value to humanity as incentives to repentance and improvement of life warnings, indeed, so precious that they could not be spared without danger to the moral government of the world. And this belief in the portentous character of comets as an essential part of the Divine government, being, as it was thought, in full accord with Scripture, was made for centuries a source of terror to humanity. To say nothing of examples in the earlier periods, comets in the tenth century especially increased the distress of all Europe. In the middle of the eleventh century a comet was thought to

accompany the death of Edward the Confessor and to presage the Norman conquest; the traveller in France to day may see this belief as it was then wrought into the Bayeux tapestry.

For evidences of this widespread terror, see chronicles of Raoul Glaber, Guillaume de Nangis, William of Malmesbury, Florence of Worcester, Ordericus Vitalis, et al., passim, and the Anglo Saxon Chronicle (in the Rolls Series). For very thrilling pictures of this horror in England, see Freeman, Norman Conquest, vol. iii, pp. 640-644, and William Rufus, vol. ii, p. 118. For the Bayeau tapestry, see Bruce, Bayeux Tapestry Elucidated, plate vii and p. 86; also Guillemin, World of Comets, p. 24. There is a large photographic copy, in the South Kensington Museum at London, of the original, wrought, as is generally believed, by the wife of William the Conqueror and her ladies, and is still preserved in the town museum at Bayeux.

Nearly every decade of years throughout the Middle Ages saw Europe plunged into alarm by appearances of this

sort, but the culmination seems to have been reached in 1456. At that time the Turks, after a long effort, had made good their footing in Europe. A large statesmanship or generalship might have kept them out; but, while different religious factions were disputing over petty shades of dogma, they had advanced, had taken Constantinople, and were evidently securing their foothold. Now came the full bloom of this superstition. A comet appeared. The Pope of that period, Calixtus III, though a man of more than ordinary ability, was saturated with the ideas of his time. Alarmed at this monster, if we are to believe the contemporary historian, this infallible head of the Church solemnly "decreed several days of prayer for the averting of the wrath of God, that whatever calamity impended might be turned from the Christians and against the Turks." And, that all might join daily in this petition, there was then established that midday Angelus which has ever since called good Catholics to prayer against the powers of evil. Then, too, was incorporated into a litany the plea, "From

the Turk and the comet, good Lord, deliver us." Never was papal intercession less effective; for the Turk has held Constantinople from that day to this, while the obstinate comet, being that now known under the name of Halley, has returned imperturbably at short periods ever since.

The usual statement is, that Calixtus excommunicated the comet by a bull, and this is accepted by Arago, Grant, Hoefer, Guillemin, Watson, and many historians of astronomy. Hence the parallel is made on a noted occasion by President Lincoln. No such bull, however, is to be found in the published Bulleria, and that establishing the Angelus (as given by Raynaldus in the Annales Eccl.) contains no mention of the comet. But the authority of Platina (in his Vitae Pontificum, Venice, 1479, sub Calistus III) who was not only in Rome at the time, but when he wrote his history, archivist of the Vatican, is final as to the Pope's attitude. Platina's authority was never questioned until modern science changed the ideas of

the world. The recent attempt of Pastor (in his Geschichte der Papste) to pooh pooh down the whole matter is too evident an evasion to carry weight with those who know how even the most careful histories have to be modified to suit the views of the censorship at Rome.

But the superstition went still further. It became more and more incorporated into what was considered "scriptural science" and "sound learning." The encyclopedic summaries, in which the science of the Middle Ages and the Reformation period took form, furnish abundant proofs of this.

Yet scientific observation was slowly undermining this structure. The inspired prophecy of Seneca had not been forgotten. Even as far back as the ninth century, in the midst of the sacred learning so abundant at the court of Charlemagne and his successors, we find a scholar protesting against the accepted doctrine. In the thirteenth century we have a mild question by Albert the Great as to the supposed influence of comets upon individuals; but the

prevailing theological current was too strong, and he finally yielded to it in this as in so many other things.

So, too, in the sixteenth century, we have Copernicus refusing to accept the usual theory, Paracelsus writing to Zwingli against it, and Julius Caesar Scaliger denouncing it as "ridiculous folly."

As to encyclopedic summaries, see Vincent of Beauvais, Speculum Naturale, and the various editions of Reisch's Margarita Philosophica. For Charlemagne's time, see Champion, La Fin du Monde, p. 156; Leopardi, Errori Popolari, p. 165. As to Albert the Great's question, see Heller, Geschichte der Physik, vol. i, p. 188. As to scepticism in the sixteenth century, see Champion, La Fin du Monde, pp. 155, 156; and for Scaliger, Dudith's book, cited below.

At first this scepticism only aroused the horror of theologians and increased the vigour of ecclesiastics; both asserted the theological theory of comets all the more strenuously as based on scriptural truth. During the

sixteenth century France felt the influence of one of her greatest men on the side of this superstition. Jean Bodin, so far before his time in political theories, was only thoroughly abreast of it in religious theories: the same reverence for the mere letter of Scripture which made him so fatally powerful in supporting the witchcraft delusion, led him to support this theological theory of comets but with a difference: he thought them the souls of men, wandering in space, bringing famine, pestilence, and war.

Not less strong was the same superstition in England. Based upon mediaeval theology, it outlived the revival of learning. From a multitude of examples a few may be selected as typical. Early in the sixteenth century Polydore Virgil, an ecclesiastic of the unreformed Church, alludes, in his English History, to the presage of the death of the Emperor Constantine by a comet as to a simple matter of fact; and in his work on prodigies he pushes this superstition to its most extreme point, exhibiting comets

as preceding almost every form of calamity.

In 1532, just at the transition period from the old Church to the new, Cranmer, paving the way to his archbishopric, writes from Germany to Henry VIII, and says of the comet then visible: "What strange things these tokens do signify to come hereafter, God knoweth; for they do not lightly appear but against some great matter."

Twenty years later Bishop Latimer, in an Advent sermon, speaks of eclipses, rings about the sun, and the like, as signs of the approaching end of the world.

For Bodin, see Theatr., lib. ii, cited by Pingre, vol. i, p. 45; also a vague citation in Baudrillart, Bodin et son Temps, p. 360. For Polydore Virgil, see English History, p. 97 (in Camden Society Publications). For Cranmer, see Remains, vol. ii, p. 535 (in Parker Society Publications). For Latimer, see Sermons, second Sunday in Advent, 1552.

In 1580, under Queen Elizabeth, there was set forth an "order of prayer to avert God’s wrath from us, threatened by the late terrible earthquake, to be used in all parish

churches." In connection with this there was also commended to the faithful "a godly admonition for the time present"; and among the things referred to as evidence of God's wrath are comets, eclipses, and falls of snow.

This view held sway in the Church of England during Elizabeth's whole reign and far into the Stuart period: Strype, the ecclesiastical annalist, gives ample evidence of this, and among the more curious examples is the surmise that the comet of 1572 was a token of Divine wrath provoked by the St. Bartholomew massacre.

As to the Stuart period, Archbishop Spottiswoode seems to have been active in carrying the superstition from the sixteenth century to the seventeenth, and Archbishop Bramhall cites Scripture in support of it. Rather curiously, while the diary of Archbishop Laud shows so much superstition regarding dreams as portents, it shows little or none regarding comets; but Bishop Jeremy Taylor, strong as he was, evidently favoured the usual view. John Howe, the eminent Nonconformist divine in the latter part of the

century, seems to have regarded the comet superstition as almost a fundamental article of belief; he laments the total neglect of comets and portents generally, declaring that this neglect betokens want of reverence for the Ruler of the world; he expresses contempt for scientific inquiry regarding comets, insists that they may be natural bodies and yet supernatural portents, and ends by saying, "I conceive it very safe to suppose that some very considerable thing, either in the way of judgment or mercy, may ensue, according as the cry of persevering wickedness or of penitential prayer is more or less loud at that time."

For Liturgical Services of the Reign of Queen Elizabeth, see Parker Society Publications, pp. 569, 570. For Strype, see his Ecclesiastical Memorials, vol. iii, part i, p. 472; also see his Annals of the reformation, vol. ii, part ii, p. 151; and his Life of Sir Thomas Smith, pp. 161, 162. For Spottiswoode, see History of the Church of Scotland (Edinburgh reprint, 1851), vol. i, pp. 185, 186. For Bramhall, see his Works, Oxford, 1844, vol. iv, pp. 60,

307, etc. For Jeremy Taylor, see his Sermons on the Life of Christ. For John Howe, see his Works, London, 1862, vol. iv, pp. 140, 141.

The Reformed Church of Scotland supported the superstition just as strongly. John Knox saw in comets tokens of the wrath of Heaven; other authorities considered them "a warning to the king to extirpate the Papists"; and as late as 1680, after Halley had won his victory, comets were announced on high authority in the Scottish Church to be "prodigies of great judgment on these lands for our sins, for never was the Lord more provoked by a people."

While such was the view of the clergy during the sixteenth and seventeenth centuries, the laity generally accepted it as a matter of course, Among the great leaders in literature there was at least general acquiescence in it. Both Shakespeare and Milton recognise it, whether they fully accept it or not. Shakespeare makes the Duke of Bedford, lamenting at the bier of Henry V, say:

"Comets, importing change of time and

states, Brandish your crystal tresses in the sky; And with them scourge the bad revolting stars, That have consented unto Henry's death."

Milton, speaking of Satan preparing for combat, says:

"On the other side, Incensed with indignation, Satan stood. Unterrified, and like a comet burned, That fires the length of Ophiuchus huge In the arctic sky, and from its horrid hair Shakes pestilence and war."

We do indeed find that in some minds the discoveries of Tycho Brahe and Kepler begin to take effect, for, in 1621, Burton in his Anatomy of Melancholy alludes to them as changing public opinion somewhat regarding comets; and, just before the middle of the century, Sir Thomas Browne expresses a doubt whether comets produce such terrible effects, "since it is found that many of them are above the moon." Yet even as late as the last years of the seventeenth century we have English authors of much power battling for this supposed scriptural view and among the natural and typical results we find, in 1682, Ralph Thoresby, a Fellow

of the Royal Society, terrified at the comet of that year, and writing in his diary the following passage: "Lord, fit us for whatever changes it may portend; for, though I am not ignorant that such meteors proceed from natural causes, yet are they frequently also the presages of imminent calamities." Interesting is it to note here that this was Halley's comet, and that Halley was at this very moment making those scientific studies upon it which were to free the civilized world forever from such terrors as distressed Thoresby.

The belief in comets as warnings against sin was especially one of those held "always, everywhere, and by all," and by Eastern Christians as well as by Western. One of the most striking scenes in the history of the Eastern Church is that which took place at the condemnation of Nikon, the great Patriarch of Moscow. Turning toward his judges, he pointed to a comet then blazing in the sky, and said, "God's besom shall sweep you all away!"

Of all countries in western Europe, it was in Germany

and German Switzerland that this superstition took strongest hold. That same depth of religious feeling which produced in those countries the most terrible growth of witchcraft persecution, brought superstition to its highest development regarding comets. No country suffered more from it in the Middle Ages. At the Reformation Luther declared strongly in favour of it. In one of his Advent sermons he said, "The heathen write that the comet may arise from natural causes, but God creates not one that does not foretoken a sure calamity." Again he said, "Whatever moves in the heaven in an unusual way is certainly a sign of God's wrath."

And sometimes, yielding to another phase of his belief, he declared them works of the devil, and declaimed against them as "harlot stars."

Melanchthon, too, in various letters refers to comets as heralds of Heaven's wrath, classing them, with evil conjunctions of the planets and abortive births, among the "signs" referred to in Scripture. Zwingli, boldest of the

greater Reformers in shaking off traditional beliefs, could not shake off this, and insisted that the comet of 1531 betokened calamity. Arietus, a leading Protestant theologian, declared, "The heavens are given us not merely for our pleasure, but also as a warning of the wrath of God for the correction of our lives." Lavater insisted that comets are signs of death or calamity, and cited proofs from Scripture.

Catholic and Protestant strove together for the glory of this doctrine. It was maintained with especial vigour by Fromundus, the eminent professor and Doctor of Theology at the Catholic University of Louvain, who so strongly opposed the Copernican system; at the beginning of the seventeenth century, even so gifted an astronomer as Kepler yielded somewhat to the belief; and near the end of that century Voigt declared that the comet of 1618 clearly presaged the downfall of the Turkish Empire, and he stigmatized as "atheists and Epicureans" all who did not believe comets to be God’s warnings.

II. THEOLOGICAL EFFORTS TO CRUSH THE SCIENTIFIC VIEW

Out of this belief was developed a great series of efforts to maintain the theological view of comets, and to put down forever the scientific view. These efforts may be divided into two classes: those directed toward learned men and scholars, through the universities, and those directed toward the people at large, through the pulpits. As to the first of these, that learned men and scholars might be kept in the paths of "sacred science" and "sound learning," especial pains was taken to keep all knowledge of the scientific view of comets as far as possible from students in the universities. Even to the end of the seventeenth century the oath generally required of professors of astronomy over a large part of Europe prevented their teaching that comets are heavenly bodies obedient to law. Efforts just as earnest were made to fasten into students' minds the theological theory. Two or three examples out of

many may serve as types. First of these may be named the teaching of Jacob Heerbrand, professor at the University of Tubingen, who in 1577 illustrated the moral value of comets by comparing the Almighty sending a comet, to the judge laying the executioner's sword on the table between himself and the criminal in a court of justice; and, again, to the father or schoolmaster displaying the rod before naughty children. A little later we have another churchman of great importance in that region, Schickhart, head pastor and superintendent at Goppingen, preaching and publishing a comet sermon, in which he denounces those who stare at such warnings of God without heeding them, and compares them to "calves gaping at a new barn door." Still later, at the end of the seventeenth century, we find Conrad Dieterich, director of studies at the University of Marburg, denouncing all scientific investigation of comets as impious, and insisting that they are only to be regarded as "signs and wonders."

The results of this ecclesiastical pressure upon science

in the universities were painfully shown during generation after generation, as regards both professors and students; and examples may be given typical of its effects upon each of these two classes.

The first of these is the case of Michael Maestlin. He was by birth a Swabian Protestant, was educated at Tubingen as a pupil of Apian, and, after a period of travel, was settled as deacon in the little parish of Backnang, when the comet of 1577 gave him an occasion to apply his astronomical studies. His minute and accurate observation of it is to this day one of the wonders of science. It seems almost impossible that so much could be accomplished by the naked eye. His observations agreed with those of Tycho Brahe, and won for Maestlin the professorship of astronomy in the University of Heidelberg. No man had so clearly proved the supralunar position of a comet, or shown so conclusively that its motion was not erratic, but regular. The young astronomer, though Apian's pupil, was an avowed Copernican and the destined master and friend

of Kepler. Yet, in the treatise embodying his observations, he felt it necessary to save his reputation for orthodoxy by calling the comet a "new and horrible prodigy," and by giving a chapter of "conjectures on the signification of the present comet," in which he proves from history that this variety of comet betokens peace, but peace purchased by a bloody victory. That he really believed in this theological theory seems impossible; the very fact that his observations had settled the supralunar character and regular motion of comets proves this. It was a humiliation only to be compared to that of Osiander when he wrote his grovelling preface to the great book of Copernicus. Maestlin had his reward: when, a few years, later his old teacher, Apian, was driven from his chair at Tubingen for refusing to sign the Lutheran Concord Book, Maestlin was elected to his place.

Not less striking was the effect of this theological pressure upon the minds of students. Noteworthy as an example of this is the book of the Leipsic lawyer, Buttner.

From no less than eighty six biblical texts he proves the Almighty's purpose of using the heavenly bodies for the instruction of men as to future events, and then proceeds to frame exhaustive tables, from which, the time and place of the comet's first appearance being known, its signification can be deduced. This manual he gave forth as a triumph of religious science, under the name of the Comet Hour Book.

The same devotion to the portent theory is found in the universities of Protestant Holland. Striking is it to see in the sixteenth century, after Tycho Brahe's discovery, the Dutch theologian, Gerard Vossius, Professor of Theology and Eloquence at Leyden, lending his great weight to the superstition. "The history of all times," he says, "shows comets to be the messengers of misfortune. It does not follow that they are endowed with intelligence, but that there is a deity who makes use of them to call the human race to repentance." Though familiar with the works of Tycho Brahe, he finds it "hard to believe" that all comets

are ethereal, and adduces several historical examples of sublunary ones.

Nor was this attempt to hold back university teaching to the old view of comets confined to Protestants. The Roman Church was, if possible, more strenuous in the same effort. A few examples will serve as types, representing the orthodox teaching at the great centres of Catholic theology.

One of these is seen in Spain. The eminent jurist Torreblanca was recognised as a controlling authority in all the universities of Spain, and from these he swayed in the seventeenth century the thought of Catholic Europe, especially as to witchcraft and the occult powers in Nature. He lays down the old cometary superstition as one of the foundations of orthodox teaching: Begging the question, after the fashion of his time, he argues that comets can not be stars, because new stars always betoken good, while comets betoken evil.

The same teaching was given in the Catholic universities of the Netherlands. Fromundus, at Louvain, the

enemy of Galileo, steadily continued his crusade against all cometary heresy.

But a still more striking case is seen in Italy. The reverend Father Augustin de Angelis, rector of the Clementine College at Rome, as late as 1673, after the new cometary theory had been placed beyond reasonable doubt, and even while Newton was working out its final demonstration, published a third edition of his Lectures on Meteorology. It was dedicated to the Cardinal of Hesse, and bore the express sanction of the Master of the Sacred Palace at Rome and of the head of the religious order to which De Angelis belonged. This work deserves careful analysis, not only as representing the highest and most approved university teaching of the time at the centre of Roman Catholic Christendom, but still more because it represents that attempt to make a compromise between theology and science, or rather the attempt to confiscate science to the uses of theology, which we so constantly find whenever the triumph of science in any field has become

inevitable.

As to the scientific element in this compromise, De Angelis holds, in his general introduction regarding meteorology, that the main material cause of comets is "exhalation," and says, "If this exhalation is thick and sticky, it blazes into a comet." And again he returns to the same view, saying that "one form of exhalation is dense, hence easily inflammable and long retentive of fire, from which sort are especially generated comets." But it is in his third lecture that he takes up comets specially, and his discussion of them is extended through the fourth, fifth, and sixth lectures. Having given in detail the opinions of various theologians and philosophers, he declares his own in the form of two conclusions. The first of these is that "comets are not heavenly bodies, but originate in the earth's atmosphere below the moon; for everything heavenly is eternal and incorruptible, but comets have a beginning and ending ergo, comets can not be heavenly bodies." This, we may observe, is levelled at the observations and reasonings

of Tycho Brahe and Kepler, and is a very good illustration of the scholastic and mediaeval method the method which blots out an ascertained fact by means of a metaphysical formula. His second conclusion is that "comets are of elemental and sublunary nature; for they are an exhalation hot and dry, fatty and well condensed, inflammable and kindled in the uppermost regions of the air." He then goes on to answer sundry objections to this mixture of metaphysics and science, and among other things declares that "the fatty, sticky material of a comet may be kindled from sparks falling from fiery heavenly bodies or from a thunderbolt"; and, again, that the thick, fatty, sticky quality of the comet holds its tail in shape, and that, so far are comets from having their paths beyond the, moon’s orbit, as Tycho Brahe and Kepler thought, he himself in 1618 saw "a bearded comet so near the summit of Vesuvius that it almost seemed to touch it." As to sorts and qualities of comets, he accepts Aristotle’s view, and divides them into bearded and tailed. He goes on into long disquisitions

upon their colours, forms, and motions. Under this latter head he again plunges deep into a sea of metaphysical considerations, and does not reappear until he brings up his compromise in the opinion that their movement is as yet uncertain and not understood, but that, if we must account definitely for it, we must say that it is effected by angels especially assigned to this service by Divine Providence. But, while proposing this compromise between science and theology as to the origin and movement of comets, he will hear to none as regards their mission as "signs and wonders" and presages of evil. He draws up a careful table of these evils, arranging them in the following order: Drought, wind, earthquake, tempest, famine, pestilence, war, and, to clinch the matter, declares that the comet observed by him in 1618 brought not only war, famine, pestilence, and earthquake, but also a general volcanic eruption, "which would have destroyed Naples, had not the blood of the invincible martyr Januarius withstood it."

It will be observed, even from this sketch, that, while the learned Father Augustin thus comes infallibly to the mediaeval conclusion, he does so very largely by scientific and essentially modern processes, giving unwonted prominence to observation, and at times twisting scientific observation into the strand with his metaphysics. The observations and methods of his science are sometimes shrewd, sometimes comical. Good examples of the latter sort are such as his observing that the comet stood very near the summit of Vesuvius, and his reasoning that its tail was kept in place by its stickiness. But observations and reasonings of this sort are always the first homage paid by theology to science as the end of their struggle approaches.

Equally striking is an example seen a little later in another part of Europe; and it is the more noteworthy because Halley and Newton had already fully established the modern scientific theory. Just at the close of the seventeenth century the Jesuit Reinzer, professor at Linz, put forth his Meteorologia Philosophico Politica, in which

all natural phenomena received both a physical and a moral interpretation. It was profusely and elaborately illustrated, and on account of its instructive contents was in 1712 translated into German for the unlearned reader. The comet receives, of course, great attention. "It appears," says Reinzer, "only then in the heavens when the latter punish the earth, and through it (the comet) not only predict but bring to pass all sorts of calamity And, to that end, its tail serves for a rod, its hair for weapons and arrows, its light for a threat, and its heat for a sign of anger and vengeance." Its warnings are threefold: (1) "Comets, generated in the air, betoken NATURALLY drought, wind, earthquake, famine, and pestilence." (2) "Comets can indirectly, in view of their material, betoken wars, tumults, and the death of princes; for, being hot and dry, they bring the moistnesses (Feuchtigkeiten) in the human body to an extraordinary heat and dryness, increasing the gall; and, since the emotions depend on the temperament and condition of the body, men are through this change driven

to violent deeds, quarrels, disputes, and finally to arms: especially is this the result with princes, who are more delicate and also more arrogant than other men, and whose moistnesses are more liable to inflammation of this sort, inasmuch as they live in luxury and seldom restrain themselves from those things which in such a dry state of the heavens are especially injurious." (3) "All comets, whatever prophetic significance they may have naturally in and of themselves, are yet principally, according to the Divine pleasure, heralds of the death of great princes, of war, and of other such great calamities; and this is known and proved, first of all, from the words of Christ himself: ‘Nation shall rise against nation, and kingdom against kingdom; and great earthquakes shall be in divers places, and famines, and pestilences; and fearful sights and great signs shall there be from heaven.’"

While such pains was taken to keep the more highly educated classes in the "paths of scriptural science and sound learning; at the universities, equal efforts were made

to preserve the cometary orthodoxy of the people at large by means of the pulpits. Out of the mass of sermons for this purpose which were widely circulated I will select just two as typical, and they are worthy of careful study as showing some special dangers of applying theological methods to scientific facts. In the second half of the sixteenth century the recognised capital of orthodox Lutheranism was Magdeburg, and in the region tributary to this metropolis no Church official held a more prominent station than the "Superintendent," or Lutheran bishop, of the neighbouring Altmark. It was this dignitary, Andreas Celichius by name, who at Magdeburg, in 1578, gave to the press his Theological Reminder of the New Comet. After deprecating as blasphemous the attempt of Aristotle to explain the phenomenon otherwise than as a supernatural warning from God to sinful man, he assures his hearers that "whoever would know the comet's real source and nature must not merely gape and stare at the scientific theory that it is an earthy, greasy, tough, and sticky vapour and

mist, rising into the upper air and set ablaze by the celestial heat." Far more important for them is it to know what this vapour is. It is really, in the opinion of Celichius, nothing more or less than "the thick smoke of human sins, rising every day, every hour, every moment, full of stench and horror, before the face of God, and becoming gradually so thick as to form a comet, with curled and plaited tresses, which at last is kindled by the hot and fiery anger of the Supreme Heavenly Judge." He adds that it is probably only through the prayers and tears of Christ that this blazing monument of human depravity becomes visible to mortals. In support of this theory, he urges the "coming up before God" of the wickedness of Sodom and Gomorrah and of Nineveh, and especially the words of the prophet regarding Babylon, "Her stench and rottenness is come up before me." That the anger of God can produce the conflagration without any intervention of Nature is proved from the Psalms, "He sendeth out his word and melteth them." From the position of the comet, its course, and the

direction of its tail he augurs especially the near approach of the judgment day, though it may also betoken, as usual, famine, pestilence, and war. "Yet even in these days," he mourns, "there are people reckless and giddy enough to pay no heed to such celestial warnings, and these even cite in their own defence the injunction of Jeremiah not to fear signs in the heavens." This idea he explodes, and shows that good and orthodox Christians, while not superstitious like the heathen, know well "that God is not bound to his creation and the ordinary course of Nature, but must often, especially in these last dregs of the world, resort to irregular means to display his anger at human guilt."

The other typical case occurred in the following century and in another part of Germany. Conrad Dieterich was, during the first half of the seventeenth century, a Lutheran ecclesiastic of the highest authority. His ability as a theologian had made him Archdeacon of Marburg, Professor of Philosophy and Director of Studies at the University of Giessen, and "Superintendent," or Lutheran

bishop, in southwestern Germany. In the year 162O, on the second Sunday in Advent, in the great Cathedral of Ulm, he developed the orthodox doctrine of comets in a sermon, taking up the questions: 1. What are comets? 2. What do they indicate? 3. What have we to do with their significance? This sermon marks an epoch. Delivered in that stronghold of German Protestantism and by a prelate of the highest standing, it was immediately printed, prefaced by three laudatory poems from different men of note, and sent forth to drive back the scientific, or, as it was called, the "godless," view of comets. The preface shows that Dieterich was sincerely alarmed by the tendency to regard comets as natural appearances. His text was taken from the twenty fifth verse of the twenty first chapter of St. Luke: "And there shall be signs in the sun, and in the moon, and in the stars; and upon the earth distress of nations, with perplexity; the sea and the waves roaring." As to what comets are, he cites a multitude of philosophers, and, finding that they differ among themselves, he uses a form

of argument not uncommon from that day to this, declaring that this difference of opinion proves that there is no solution of the problem save in revelation, and insisting that comets are "signs especially sent by the Almighty to warn the earth." An additional proof of this he finds in the forms of comets. One, he says, took the form of a trumpet; another, of a spear; another of a goat; another, of a torch; another, of a sword; another, of an arrow; another, of a sabre; still another, of a bare arm. From these forms of comets he infers that we may divine their purpose. As to their creation, he quotes John of Damascus and other early Church authorities in behalf of the idea that each comet is a star newly created at the Divine command, out of nothing, and that it indicates the wrath of God. As to their purpose, having quoted largely from the Bible and from Luther, he winds up by insisting that, as God can make nothing in vain, comets must have some distinct object; then, from Isaiah and Joel among the prophets, from Matthew, Mark, and Luke among the evangelists, from Origen and John

Chrysostom among the fathers, from Luther and Melanchthon among the Reformers, he draws various texts more or less conclusive to prove that comets indicate evil and only evil; and he cites Luther's Advent sermon to the effect that, though comets may arise in the course of Nature, they are still signs of evil to mankind. In answer to the theory of sundry naturalists that comets are made up of "a certain fiery, warm, sulphurous, saltpetery, sticky fog," he declaims: "Our sins, our sins: they are the fiery heated vapours, the thick, sticky, sulphurous clouds which rise from the earth toward heaven before God." Throughout the sermon Dieterich pours contempt over all men who simply investigate comets as natural objects, calls special attention to a comet then in the heavens resembling a long broom or bundle of rods, and declares that he and his hearers can only consider it rightly "when we see standing before us our Lord God in heaven as an angry father with a rod for his children." In answer to the question what comets signify, he commits himself entirely to the idea that

they indicate the wrath of God, and therefore calamities of every sort. Page after page is filled with the records of evils following comets. Beginning with the creation of the world, he insists that the first comet brought on the deluge of Noah, and cites a mass of authorities, ranging from Moses and Isaiah to Albert the Great and Melanchthon, in support of the view that comets precede earthquakes, famines, wars, pestilences, and every form of evil. He makes some parade of astronomical knowledge as to the greatness of the sun and moon, but relapses soon into his old line of argument. Imploring his audience not to be led away from the well established belief of Christendom and the principles of their fathers, he comes back to his old assertion, insists that "our sins are the inflammable material of which comets are made," and winds up with a most earnest appeal to the Almighty to spare his people.

Similar efforts from the pulpit were provoked by the great comet of 1680. Typical among these was the effort in Switzerland of Pastor Heinrich Erni, who, from the

Cathedral of Zurich, sent a circular letter to the clergy of that region showing the connection of the eleventh and twelfth verses of the first chapter of Jeremiah with the comet, giving notice that at his suggestion the authorities had proclaimed a solemn fast, and exhorting the clergy to preach earnestly on the subject of this warning.

Nor were the interpreters of the comet's message content with simple prose. At the appearance of the comet of 1618, Grasser and Gross, pastors and doctors of theology at Basle, put forth a collection of doggerel rhymes to fasten the orthodox theory into the minds of school children and peasants. One of these may be translated:

"I am a Rod in God's right hand threatening the German and foreign land."

Others for a similar purpose taught:

"Eight things there be a Comet brings, When it on high doth horrid range: Wind, Famine, Plague, and Death to Kings, War, Earthquakes, Floods, and Direful Change."

Great ingenuity was shown in meeting the advance of

science, in the universities and schools, with new texts of Scripture; and Stephen Spleiss, Rector of the Gymnasium at Schaffhausen, got great credit by teaching that in the vision of Jeremiah the "almond rod" was a tailed comet, and the "seething pot" a bearded one.

It can be easily understood that such authoritative utterances as that of Dieterich must have produced a great effect throughout Protestant Christendom; and in due time we see their working in New England. That same tendency to provincialism, which, save at rare intervals, has been the bane of Massachusetts thought from that day to this, appeared; and in 1664 we find Samuel Danforth arguing from the Bible that "comets are portentous signals of great and notable changes," and arguing from history that they "have been many times heralds of wrath to a secure and impenitent world." He cites especially the comet of 1652, which appeared just before Mr. Cotton's sickness and disappeared after his death. Morton also, in his Memorial recording the death of John Putnam, alludes to the comet of

1662 as "a very signal testimony that God had then removed a bright star and a shining light out of the heaven of his Church here into celestial glory above." Again he speaks of another comet, insisting that "it was no fiery meteor caused by exhalation, but it was sent immediately by God to awaken the secure world," and goes on to show how in that year "it pleased God to smite the fruits of the earth namely, the wheat in special with blasting and mildew, whereby much of it was spoiled and became profitable for nothing, and much of it worth little, being light and empty. This was looked upon by the judicious and conscientious of the land as a speaking providence against the unthankfulness of many, as also against voluptuousness and abuse of the good creatures of God by licentiousness in drinking and fashions in apparel, for the obtaining whereof a great part of the principal grain was oftentimes unnecessarily expended."

But in 1680 a stronger than either of these seized upon the doctrine and wielded it with power. Increase Mather, so

open always to ideas from Europe, and always so powerful for good or evil in the cloonies, preached his sermon on "Heaven's Alarm to the World, wherein is shown that fearful sights and signs in the heavens are the presages of great calamities at hand." The texts were taken from the book of Revelation: "And the third angel sounded, and there fell a great star from heaven, burning, as it were a lamp," and "Behold, the third woe cometh quickly." In this, as in various other sermons, he supports the theological cometary theory fully. He insists that "we are fallen into the dregs of time," and that the day of judgment is evidently approaching. He explains away the words of Jeremiah "Be not dismayed at signs in the heavens" and shows that comets have been forerunners of nearly every form of evil. Having done full justice to evils thus presaged in scriptural times, he begins a similar display in modern history by citing blazing stars which foretold the invasions of Goths, Huns, Saracens, and Turks, and warns gainsayers by citing the example of Vespasian, who, after ridiculing a

comet, soon died. The general shape and appearance of comets, he thinks, betoken their purpose, and he cites Tertullian to prove them "God's sharp razors on mankind, whereby he doth poll, and his scythe whereby he doth shear down multitudes of sinful creatures." At last, rising to a fearful height, he declares: "For the Lord hath fired his beacon in the heavens among the stars of God there; the fearful sight is not yet out of sight. The warning piece of heaven is going off. Now, then, if the Lord discharge his murdering pieces from on high, and men be found in their sins unfit for death, their blood shall be upon them." And again, in an agony of supplication, he cries out: "Do we see the sword blazing over us? Let it put us upon crying to God, that the judgment be diverted and not return upon us again so speedily Doth God threaten our very heavens? O pray unto him, that he would not take away stars and send comets to succeed them."

Two years later, in August, 1682, he followed this with another sermon on "The Latter Sign," "wherein is showed

that the voice of God in signal providences, especially when repeated and iterated, ought to be hearkened unto." Here, too, of course, the comet comes in for a large share of attention. But his tone is less sure: even in the midst of all his arguments appears an evident misgiving. The thoughts of Newton in science and Bayle in philosophy were evidently tending to accomplish the prophecy of Seneca. Mather's alarm at this is clear. His natural tendency is to uphold the idea that a comet is simply a fire ball flung from the hand of an avenging God at a guilty world, but he evidently feels obliged to yield something to the scientific spirit; hence, in the Discourse concerning Comets, published in 1683, he declares: "There are those who think that, inasmuch as comets may be supposed to proceed from natural causes, there is no speaking voice of Heaven in them beyond what is to be said of all other works of God. But certain it is that many things which may happen according to the course of Nature are portentous signs of Divine anger and prognostics of great evils hastening upon

the world." He then notices the eclipse of August, 1672, and adds: "That year the college was eclipsed by the death of the learned president there, worthy Mr. Chauncey and two colonies namely, Massachusetts and Plymouth by the death of two governors, who died within a twelvemonth after Shall, then, such mighty works of God as comets are be insignificant things?"

III. THE INVASION OF SCEPTICISM

Vigorous as Mather's argument is, we see scepticism regarding "signs" continuing to invade the public mind; and, in spite of his threatenings, about twenty years after we find a remarkable evidence of this progress in the fact that this scepticism has seized upon no less a personage than that colossus of orthodoxy, his thrice illustrious son, Cotton Mather himself; and him we find, in 1726, despite the arguments of his father, declaring in his Manuductio: "Perhaps there may be some need for me to caution you against being dismayed at the signs of the heavens, or

having any superstitious fancies upon eclipses and the like I am willing that you be apprehensive of nothing portentous in blazing stars. For my part, I know not whether all our worlds, and even the sun itself, may not fare the better for them."

Curiously enough, for this scientific scepticism in Cotton Mather there was a cause identical with that which had developed superstition in the mind of his father. The same provincial tendency to receive implicitly any new European fashion in thinking or speech wrought upon both, plunging one into superstition and drawing the other out of it.

European thought, which New England followed, had at last broken away in great measure from the theological view of comets as signs and wonders. The germ of this emancipating influence was mainly in the great utterance of Seneca; and we find in nearly every century some evidence that this germ was still alive. This life became more and more evident after the Reformation period, even though

theologians in every Church did their best to destroy it. The first series of attacks on the old theological doctrine were mainly founded in philosophic reasoning. As early as the first half of the sixteenth century we hear Julius Caesar Scaliger protesting against the cometary superstition as "ridiculous folly." Of more real importance was the treatise of Blaise de Vigenere, published at Paris in 1578. In this little book various statements regarding comets as signs of wrath or causes of evils are given, and then followed by a very gentle and quiet discussion, usually tending to develop that healthful scepticism which is the parent of investigation. A fair example of his mode of treating the subject is seen in his dealing with a bit of "sacred science." This was simply that "comets menace princes and kings with death because they live more delicately than other people; and, therefore, the air thickened and corrupted by a comet would be naturally more injurious to them than to common folk who live on coarser food." To this De Vigenere answers that there are

very many persons who live on food as delicate as that enjoyed by princes and kings, and yet receive no harm from comets. He then goes on to show that many of the greatest monarchs in history have met death without any comet to herald it.

In the same year thoughtful scepticism of a similar sort found an advocate in another part of Europe. Thomas Erastus, the learned and devout professor of medicine at Heidelberg, put forth a letter dealing in the plainest terms with the superstition. He argued especially that there could be no natural connection between the comet and pestilence, since the burning of an exhalation must tend to purify rather than to infect the air. In the following year the eloquent Hungarian divine Dudith published a letter in which the theological theory was handled even more shrewdly. for he argued that, if comets were caused by the sins of mortals, they would never be absent from the sky. But these utterances were for the time brushed aside by the theological leaders of thought as shallow or impious.

In the seventeenth century able arguments against the superstition, on general grounds, began to be multiplied. In Holland, Balthasar Bekker opposed this, as he opposed the witchcraft delusion, on general philosophic grounds; and Lubienitzky wrote in a compromising spirit to prove that comets were as often followed by good as by evil events. In France, Pierre Petit, formerly geographer of Louis XIII, and an intimate friend of Descartes, addressed to the young Louis XIV a vehement protest against the superstition, basing his arguments not on astronomy, but on common sense. A very effective part of the little treatise was devoted to answering the authority of the fathers of the early Church. To do this, he simply reminded his readers that St. Augustine and St. John Damascenus had also opposed the doctrine of the antipodes. The book did good service in France, and was translated in Germany a few years later.

All these were denounced as infidels and heretics, yet none the less did they set men at thinking, and prepare the

way for a far greater genius; for toward the end of the same century the philosophic attack was taken up by Pierre Bayle, and in the whole series of philosophic champions he is chief. While professor at the University of Sedan he had observed the alarm caused by the comet of 1680, and he now brought all his reasoning powers to bear upon it. Thoughts deep and witty he poured out in volume after volume. Catholics and Protestants were alike scandalized. Catholic France spurned him, and Jurieu, the great Reformed divine, called his cometary views "atheism," and tried hard to have Protestant Holland condemn him. Though Bayle did not touch immediately the mass of mankind, he wrought with power upon men who gave themselves the trouble of thinking. It was indeed unfortunate for the Church that theologians, instead of taking the initiative in this matter, left it to Bayle; for, in tearing down the pretended scriptural doctrine of comets, he tore down much else: of all men in his time, no one so thoroughly prepared the way for Voltaire.

Bayle's whole argument is rooted in the prophecy of Seneca. He declares: "Comets are bodies subject to the ordinary law of Nature, and not prodigies amenable to no law." He shows historically that there is no reason to regard comets as portents of earthly evils. As to the fact that such evils occur after the passage of comets across the sky, he compares the person believing that comets cause these evils to a woman looking out of a window into a Paris street and believing that the carriages pass because she looks out. As to the accomplishment of some predictions, he cites the shrewd saying of Henry IV, to the effect that "the public will remember one prediction that comes true better than all the rest that have proved false." Finally, he sums up by saying: "The more we study man, the more does it appear that pride is his ruling passion, and that he affects grandeur even in his misery. Mean and perishable creature that he is, he has been able to persuade men that he can not die without disturbing the whole course of Nature and obliging the heavens to put themselves to fresh expense. In

order to light his funeral pomp. Foolish and ridiculous vanity! If we had a just idea of the universe, we should soon comprehend that the death or birth of a prince is too insignificant a matter to stir the heavens."

This great philosophic champion of right reason was followed by a literary champion hardly less famous; for Fontenelle now gave to the French theatre his play of The Comet, and a point of capital importance in France was made by rendering the army of ignorance ridiculous.

Such was the line of philosophic and literary attack, as developed from Scaliger to Fontenelle. But beneath and in the midst of all of it, from first to last, giving firmness, strength, and new sources of vitality to it, was the steady development of scientific effort; and to the series of great men who patiently wrought and thought out the truth by scientific methods through all these centuries belong the honours of the victory.

For generations men in various parts of the world had been making careful observations on these strange bodies.

As far back as the time when Luther and Melanchthon and Zwingli were plunged into alarm by various comets from 1531 to 1539, Peter Apian kept his head sufficiently cool to make scientific notes of their paths through the heavens. A little later, when the great comet of 1556 scared popes, emperors, and reformers alike, such men as Fabricius at Vienna and Heller at Nuremberg quietly observed its path. In vain did men like Dieterich and Heerbrand and Celich from various parts of Germany denounce such observations and investigations as impious; they were steadily continued, and in 1577 came the first which led to the distinct foundation of the modern doctrine. In that year appeared a comet which again plunged Europe into alarm. In every European country this alarm was strong, but in Germany strongest of all. The churches were filled with terror stricken multitudes. Celich preaching at Magdeburg was echoed by Heerbrand preaching at Tubingen, and both these from thousands of other pulpits, Catholic and Protestant, throughout Europe. In the midst of all this din

and outcry a few men quietly but steadily observed the monster; and Tycho Brahe announced, as the result, that its path lay farther from the earth than the orbit of the moon. Another great astronomical genius, Kepler, confirmed this. This distinct beginning of the new doctrine was bitterly opposed by theologians; they denounced it as one of the evil results of that scientific meddling with the designs of Providence against which they had so long declaimed in pulpits and professors' chairs; they even brought forward some astronomers ambitious or wrong headed enough to testify that Tycho and Kepler were in error.

Nothing could be more natural than such opposition; for this simple announcement by Tycho Brahe began a new era. It shook the very foundation of cometary superstition. The Aristotelian view, developed by the theologians, was that what lies within the moon's orbit appertains to the earth and is essentially transitory and evil, while what lies beyond it belongs to the heavens and is permanent, regular, and pure. Tycho Brahe and Kepler, therefore, having by

means of scientific observation and thought taken comets out of the category of meteors and appearances in the neighbourhood of the earth, and placed them among the heavenly bodies, dealt a blow at the very foundations of the theological argument, and gave a great impulse to the idea that comets are themselves heavenly bodies moving regularly and in obedience to law.

IV. THEOLOGICAL EFFORTS AT COMPROMISE. THE FINAL VICTORY OF SCIENCE.

Attempts were now made to compromise. It was declared that, while some comets were doubtless supralunar, some must be sublunar. But this admission was no less fatal on another account. During many centuries the theory favoured by the Church had been, as we have seen, that the earth was surrounded by hollow spheres, concentric and transparent, forming a number of glassy strata incasing one another "like the different coatings of an onion," and that each of these in its movement about the earth carries one or

more of the heavenly bodies. Some maintained that these spheres were crystal; but Lactantius, and with him various fathers of the Church, spoke of the heavenly vault as made of ice. Now, the admission that comets could move beyond the moon was fatal to this theory, for it sent them crashing through these spheres of ice or crystal, and therefore through the whole sacred fabric of the Ptolemaic theory.

Here we may pause for a moment to note one of the chief differences between scientific and theological reasoning considered in themselves. Kepler's main reasoning as to the existence of a law for cometary movement was right; but his secondary reasoning, that comets move nearly in straight lines, was wrong. His right reasoning was developed by Gassendi in France, by Borelli in Italy, by Hevel and Doerfel in Germany, by Eysat and Bernouilli in Switzerland, by Percy and most important of all, as regards mathematical demonstration by Newton in England. The general theory, which was true, they

accepted and developed; the secondary theory, which was found untrue, they rejected; and, as a result, both of what they thus accepted and of what they rejected, was evolved the basis of the whole modern cometary theory.

Very different was this from the theological method. As a rule, when there arises a thinker as great in theology as Kepler in science, the whole mass of his conclusions ripens into a dogma. His disciples labour not to test it, but to establish it; and while, in the Catholic Church, it becomes a dogma to be believed or disbelieved under the penalty of damnation, it becomes in the Protestant Church the basis for one more sect.

Various astronomers laboured to develop the truth discovered by Tycho and strengthened by Kepler. Cassini seemed likely to win for Italy the glory of completing the great structure; but he was sadly fettered by Church influences, and was obliged to leave most of the work to others. Early among these was Hevel. He gave reasons for believing that comets move in parabolic curves toward the

sun. Then came a man who developed this truth further Samuel Doerfel; and it is a pleasure to note that he was a clergyman. The comet of 1680, which set Erni in Switzerland, Mather in New England, and so many others in all parts of the world at declaiming, set Doerfel at thinking. Undismayed by the authority of Origen and St. John Chrysostom, the arguments of Luther, Melanchthon, and Zwingli, the outcries of Celich, Heerbrand, and Dieterich, he pondered over the problem in his little Saxon parsonage, until in 1681 he set forth his proofs that comets are heavenly bodies moving in parabolas of which the sun is the focus. Bernouilli arrived at the same conclusion; and, finally, this great series of men and works was closed by the greatest of all, when Newton, in 1686, having taken the data furnished by the comet of 1680, demonstrated that comets are guided in their movements by the same principle that controls the planets in their orbits. Thus was completed the evolution of this new truth in science.

Yet we are not to suppose that these two great series

of philosophical and scientific victories cleared the field of all opponents. Declamation and pretended demonstration of the old theologic view were still heard; but the day of complete victory dawned when Halley, after most thorough observation and calculation, recognised the comet of 1682 as one which had already appeared at stated periods, and foretold its return in about seventy five years; and the battle was fully won when Clairaut, seconded by Lalande and Mme. Lepaute, predicted distinctly the time when the comet would arrive at its perihelion, and this prediction was verified. Then it was that a Roman heathen philosopher was proved more infallible and more directly under Divine inspiration than a Roman Christian pontiff; for the very comet which the traveller finds to day depicted on the Bayeux tapestry as portending destruction to Harold and the Saxons at the Norman invasion of England, and which was regarded by Pope Calixtus as portending evil to Christendom, was found six centuries later to be, as Seneca had prophesied, a heavenly body obeying the great

laws of the universe, and coming at regular periods. Thenceforth the whole ponderous enginery of this superstition, with its proof texts regarding "signs in the heavens," its theological reasoning to show the moral necessity of cometary warnings, and its ecclesiastical fulminations against the "atheism, godlessness, and infidelity" of scientific investigation, was seen by all thinking men to be as weak against the scientific method as Indian arrows against needle guns. Copernicus, Galileo, Cassini, Doerfel, Newton, Halley, and Clairaut had gained the victory.

It is instructive to note, even after the main battle was lost, a renewal of the attempt, always seen under like circumstances, to effect a compromise, to establish a "safe science" on grounds pseudo scientific and pseudo theologic. Luther, with his strong common sense, had foreshadowed this; Kepler had expressed a willingness to accept it. It was insisted that comets might be heavenly bodies moving in regular orbits, and even obedient to law, and yet be sent as

"signs in the heavens." Many good men clung longingly to this phase of the old belief, and in 1770 Semler, professor at Halle, tried to satisfy both sides. He insisted that, while from a scientific point of view comets could not exercise any physical influence upon the world, yet from a religious point of view they could exercise a moral influence as reminders of the Just Judge of the Universe.

So hard was it for good men to give up the doctrine of "signs in the heavens," seemingly based upon Scripture and exercising such a healthful moral tendency! As is always the case after such a defeat, these votaries of "sacred science" exerted the greatest ingenuity in devising statements and arguments to avert the new doctrine. Within our own century the great Catholic champion, Joseph de Maistre, echoed these in declaring his belief that comets are special warnings of evil. So, too, in Protestant England, in 1818, the Gentleman's Magazine stated that under the malign influence of a recent comet "flies became blind and died early in the season," and "the wife of a London

shoemaker had four children at a birth." And even as late as 1829 Mr. Forster, an English physician, published a work to prove that comets produce hot summers, cold winters, epidemics, earthquakes, clouds of midges and locusts, and nearly every calamity conceivable. He bore especially upon the fact that the comet of 1665 was coincident with the plague in London, apparently forgetting that the other great cities of England and the Continent were not thus visited; and, in a climax, announces the fact that the comet of 1663 "made all the cats in Westphalia sick."

There still lingered one little cloud patch of superstition, arising mainly from the supposed fact that comets had really been followed by a marked rise in temperature. Even this poor basis for the belief that they might, after all, affect earthly affairs was swept away, and science won here another victory; for Arago, by thermometric records carefully kept at Paris from 1735 to 1781, proved that comets had produced no effect upon temperature. Among multitudes of similar examples he

showed that, in some years when several comets appeared, the temperature was lower than in other years when few or none appeared. In 1737 there were two comets, and the weather was cool; in 1785 there was no comet, and the weather was hot; through the whole fifty years it was shown that comets were sometimes followed by hot weather, sometimes by cool, and that no rule was deducible. The victory of science was complete at every point.

But in this history there was one little exhibition so curious as to be worthy of notice, though its permanent effect upon thought was small. Whiston and Burnet, so devoted to what they considered sacred science, had determined that in some way comets must be instruments of Divine wrath. One of them maintained that the deluge was caused by the tail of a comet striking the earth; the other put forth the theory that comets are places of punishment for the damned in fact, "flying hells." The theories of Whiston and Burnet found wide acceptance also in Germany, mainly through the all powerful mediation of

Gottsched, so long, from his professor's chair at Leipsic, the dictator of orthodox thought, who not only wrote a brief tractate of his own upon the subject, but furnished a voluminous historical introduction to the more elaborate treatise of Heyn. In this book, which appeared at Leipsic in 1742, the agency of comets in the creation, the flood, and the final destruction of the world is fully proved. Both these theories were, however, soon discredited.

Perhaps the more interesting of them can best be met by another, which, if not fully established, appears much better based namely, that in 1868 the earth passed directly through the tail of a comet, with no deluge, no sound of any wailings of the damned, with but slight appearances here and there, only to be detected by the keen sight of the meteorological or astronomical observer.

In our own country superstitious ideas regarding comets continued to have some little currency; but their life was short. The tendency shown by Cotton Mather, at the beginning of the eighteenth century, toward acknowledging

the victory of science, was completed by the utterances of Winthrop, professor at Harvard, who in 1759 published two lectures on comets, in which he simply and clearly revealed the truth, never scoffing, but reasoning quietly and reverently. In one passage he says: "To be thrown into a panic whenever a comet appears, on account of the ill effects which some few of them might possibly produce, if they were not under proper direction, betrays a weakness unbecoming a reasonable being."

A happy influence in this respect was exercised on both continents by John Wesley. Tenaciously as he had held to the supposed scriptural view in so many other matters of science, in this he allowed his reason to prevail, accepted the demonstrations of Halley, and gloried in them.

The victory was indeed complete. Happily, none of the fears expressed by Conrad Dieterich and Increase Mather were realized. No catastrophe has ensued either to religion or to morals. In the realm of religion the Psalms of David remain no less beautiful, the great utterances of the Hebrew

prophets no less powerful; the Sermon on the Mount, "the first commandment, and the second, which is like unto it," the definition of "pure religion and undefiled" by St. James, appeal no less to the deepest things in the human heart. In the realm of morals, too, serviceable as the idea of firebrands thrown by the right hand of an avenging God to scare a naughty world might seem, any competent historian must find that the destruction of the old theological cometary theory was followed by moral improvement rather than by deterioration. We have but to compare the general moral tone of society to day, wretchedly imperfect as it is, with that existing in the time when this superstition had its strongest hold. We have only to compare the court of Henry VIII with the court of Victoria, the reign of the later Valois and earlier Bourbon princes with the present French Republic, the period of the Medici and Sforzas and Borgias with the period of Leo XIII and Humbert, the monstrous wickedness of the Thirty Years' War with the ennobling patriotism of the

Franco Prussian struggle, and the despotism of the miserable German princelings of the sixteenth and seventeenth centuries with the reign of the Emperor William. The gain is not simply that mankind has arrived at a clearer conception of law in the universe; not merely that thinking men see more clearly that we are part of a system not requiring constant patching and arbitrary interference; but perhaps best of all is the fact that science has cleared away one more series of those dogmas which tend to debase rather than to develop man's whole moral and religious nature. In this emancipation from terror and fanaticism, as in so many other results of scientific thinking, we have a proof of the inspiration of those great words, "THE TRUTH SHALL MAKE YOU FREE."