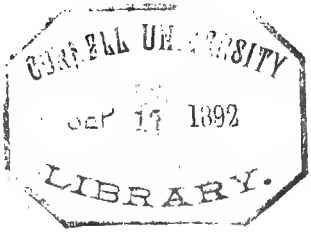


PAPERS

OF THE

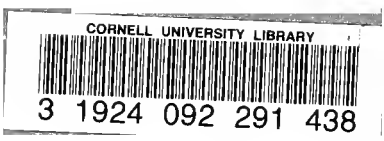
AMERICAN HISTORICAL ASSOCIATION

VOL. II. NO. 2

I

A HISTORY OF THE DOCTRINE OF COMETS

A PAPER READ BEFORE THE AMERICAN HISTORICAL ASSOCIATION AT ITS SECOND ANNUAL MEETING, SARATOGA, SEPTEMBER 10, 1885



BY

ANDREW D. WHITE
President of the Association

NEW YORK AND LONDON
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1887

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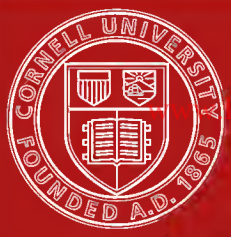
A HISTORY

OF THE

DOCTRINE OF COMETS



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A HISTORY OF THE DOCTRINE OF COMETS.

FEW chapters in the evolution of astronomy are more interesting 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 their recognition as natural in origin and obedient to law in movement. Hardly any thing 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a more vivid light upon the danger of wresting texts of Scripture to preserve ideas which observation and thought have superseded, and upon the folly of arraying ecclesiastical power against scientific discovery.

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.[1] The sacred books of China tell of similar appearances at

[1] For Crishna see Cox, "Aryan Mythology," ii., 133; the "Vishnu Purana" (Wilson's translation), bk. v., ch. 4. As to lights at the birth, or rather at the conception, of Buddha, see Bunsen, "Angel Messiah," 22, 23; Alabaster, "Wheel of the Law" (illustrations of Buddhism), 102; Edwin Arnold, "Light of Asia"; Bp. Bigandet, "Life of Gaudama, the Burmese Buddha," 30; Oldenberg, "Buddha" (English translation)," pt. i., ch. ii.

the births of Yu, the founder of the first dynasty, and of the inspired sage, Lao-tse.[1] 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.[2] The Greeks and Romans cherished similar traditions.[3] A heavenly light accompanied the birth of Æsculapius, and the births of various Cæsars were heralded in like manner.

As to the nature of these heavenly bodies, the Fathers of the Christian Church were divided. Origen thought them living creatures possessed of souls,[4] and this belief was thought warranted by the beautiful Song of the Three Children, which the Anglican communion has so wisely retained in its liturgy. Other Fathers of the church thought the stars abiding-places of the angels, and that shooting-stars were moved by angels.[5] The Gnostics considered the stars as spiritual beings governed by angels and appointed not to cause earthly events but to indicate them.[6] Philo Judæus believed the stars beneficent spirits,[7] and this belief was widely held by Jews, Greeks, and Christians. Among the Mohammedans we have a curious example of the same

[1] For Chinese legends regarding stars at the birth of Yu and Lao-tse, see Thornton, "History of China," i., 137; also Pingré, "Cométographie," 245.

[2] Regarding stars at the births of Moses and Abraham, see Calmet, "Fragments," part viii.; Baring-Gould, "Legends of Old Testament Characters," ch. xxiv.; Farrar, "Life of Christ," ch. iii. As to the Magi, see Higgins, "Anacalypsis;" Hooykaas, Ort, and Kuehnen, "Bible for Learners," vol. iii.

[3] See Bell, "Pantheon," s.v. Æsculapius and Atreus; Gibbon, "Decline and Fall," i., 151, 590; Farrar, "Life of Christ" (Amer. ed.), 52; Cox, "Tales of Ancient Greece," 41, 61, 62; Higgins, "Anacalypsis," i., 322; also Lucan, i., 529; Suetonius, "Caes.," Julius 88, Claud. 463; Seneca, "Nat. Quaest.," i., 1; Virgil, "Ecl.," ix., 47; as well as Ovid, Pliny, and other Roman poets and historians.

[4] See Origen, "De Principiis," lib. i., cap. 7.

[5] See Leopardi, "Errori Popolari," ch. xi.

[6] See Wilson, "Selections from the Prophetic Scriptures" (in Ante-Nicene Christian Library), 132.

[7] See Philo Judæus, "On the Creation of the World," cap. 18, 19; "On Monarchy," cap. 1.

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.[1] The Greeks believed that darkness overshadowed the earth at the deaths of Prometheus, Atreus, Hercules, Æsculapius, and Alexander the Great. The Roman legends held that at the death of Romulus there was darkness for six hours.[2] In the history of the Cæsars 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.[3] Nor has this mode of thinking ceased in modern times. A similar claim was made at the execution of Charles I.,[4] and Increase Mather thought an eclipse in Massachusetts an evidence of the grief of nature at the death of President Chauncey, of Harvard College.[5] 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 beautiful 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 the civilized world.[6]

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[1] For Indian theories, see Alabaster, "Wheel of the Law," 11.

[2] See Higgins, "Anacalypsis," i., 616, 617.

[3] See Suetonius, "Caes.," Julius 88, Claud. 46; Seneca, "Quaest. Nat.," i., 1, vii., 17; Pliny, "Hist. Nat.," ii., 25; Tacitus, "Ann.," xiv., 22; Josephus, xiv., 12; besides the authorities above cited.

[4] See a sermon preached before Charles II., cited by Lecky, "England in the Eighteenth Century," i., 65.

[5] He 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.

[6] For Abp. Sandys' belief see his eighteenth sermon (in Parker Soc. publications).

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 they gave rise to the direst superstition and fanaticism. The records of every nation are full of these. The Chaldeans alone among the ancient nations seem to have regarded comets without fear, and to have 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.[1] Here and there a few strong men rose as individuals 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. Such isolated utterances could not stand against the mass of superstition which upheld the doctrine that comets are "signs and wonders."[2]

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, and transmitted through the middle ages to the Reformation period; and in its transmission it was made all the more precious by supposed textual proofs from Scripture. The great Fathers of the Church committed themselves unreservedly

[1] For terror caused in Rome by comets see Pingré, "Cométographie," 165, 166. For the Chaldeans see Wolf, "Geschichte der Astronomie," 10 *et seq.*, and 181 *et seq.*; also Pingré, "Cométographie," ch. ii. For the Pythagorean notions see citation from Plutarch in Costard, "History of Astronomy," 283. For Seneca's prediction see Guillemin, "World of Comets" (translated by Glaisher), 4, 5; also Watson, "On Comets," 46.

[2] For this feeling in antiquity see the preliminary chapters of the two works last cited.

to this doctrine. Origen insisted that comets indicate catastrophes and the downfall of empires and worlds.[1] Bede, so justly revered by the English Church, declared in the seventh 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.[2] Hrabanus Maurus, the great teacher of Europe in the ninth century and an authority throughout the middle ages, adopts 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.[3] The sainted Albert the Great, the most noted genius of the mediæval church in natural science, received and developed this theory.[4] By these men and those who followed them was developed out of scriptural texts and theological principles a system that for seventeen centuries defied every advance of thought.

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

[1] See his "De Princip.," i., 7; Maury, "Lég. Pieuses," 203.
[2] See Bede, "De Nat.," xxiv.; Joh. Dam., "De Fid. Or.," ii., 7.
[3] See Maury, "La Magie et l'Astronomie," 181.
[4] See Albertus Magnus, "Opera," i., tr. iii., ch. 10, 11.

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 Cæsar:

> "When beggars die, there are no comets seen;
> The heavens themselves blaze forth the death of princes."[1]

Galeazzo, the tyrant of Milan, expressing satisfaction on his death-bed that his approaching end was of such importance as to be heralded by a comet,[2] 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.[3]

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 strengthened the prevailing belief in the approaching end of the world, and increased the distress of all Europe.[4] In the middle of

[1] "Julius Cæsar," act ii., sc. 2. [2] See Guillemin, "World of Comets," 19.

[3] See Professor Wolf's essay in the "Monatschrift des wissenschaftlichen Vereins," Zürich, 1857, p. 228.

[4] Of this the legal documents of that age afford abundant testimony. For effects of comets in the eleventh century and those following see the chronicles of Raoul Glaber, William of Nangis, and others *passim*.

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.[1]

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 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, the Turks 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., was a man of more than ordinary ability, but 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, by virtue of his position, 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, was then established that mid-day Angelus which has ever since called good Catholics to prayer against the powers of evil. Then, too, it is said, was incorporated in the 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

[1] 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," iii., 640–644, and "William Rufus," ii., 118. For the Bayeux tapestry see Bruce, "Bayeux Tapestry Elucidated," pl. vii. and p. 86; also Guillemin, "World of Comets," 24. There is a large photographic copy, in the South Kensington Museum at London, of the original, wrought by the wife of William the Conqueror and her ladies, and preserved in the town museum at Bayeux.

of Halley, has returned imperturbably at short periods ever since.[1]

But the superstition went still further. It became more and more incorporated into what was considered "scriptural science" and "sound learning." The encyclopædic summaries, in which the science of the middle ages and the Reformation period took form, furnish abundant proofs of this.[2]

Yet scientific proof 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 doctrine.[3] 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.[4]

So, too, in the sixteenth century, we have Copernicus refusing to accept the usual theory, Paracelsus writing to Zwingli against it, and Julius Cæsar Scaliger denouncing it as "ridiculous folly."[5]

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[1] 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 made on a noted occasion by President Lincoln. No such bull, however, is to be found in the published "Bullaria," and that establishing the "Angelus" (as given by Raynaldus in the "Annales Eccl.") is said to contain no mention of the comet. But the authority of Platina (in his "Vitæ 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 had changed the ideas of the world. The recent attempt of Pastor (in his "Geschichte der Päpste") 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.

[2] See, for example, Vincent of Beauvais, "Speculum Naturale," and the various editions of Reisch's "Margarita Philosophica."

[3] See Champion, "La Fin du Monde," 156; Leopardi, "Errori Popolari," 165.

[4] See Heller, "Geschichte der Physik," i., 188.

[5] For these exhibitions see Champion, "La Fin du Monde," 155, 156; and for Scaliger, Dudith's book, cited below.

At first this scepticism only aroused the horror of theologians and increased the vigor 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.[1]

Not less strong was the same superstition in England. Based upon mediæval theology, it outlived the revival of learning. From a multitude of examples I take a few that may be considered typical. Early in the sixteenth century Polydore Virgil, an ecclesiastic of the unreformed church, alludes, in his "English History," to the comet presaging the death of the Emperor Constantine 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.[2]

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."[3]

Twenty years later still, 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.[4]

In 1580, under Queen Elizabeth, there was set forth an

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[1] See Bodin, "Theatr.," lib. ii., cited by Pingré, i., 45; also a vague citation in Baudrillart, "Bodin et son Temps," 360.

[2] See Polydore Virgil, "Eng. Hist.," 97 (in Camden Soc. publications).

[3] See Cranmer's "Remains," ii., 535 (in Parker Soc. publications).

[4] See Latimer's "Sermons," second Sunday in Advent, 1552.

"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.[1]

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 revenge for the St. Bartholomew massacre at Paris.[2]

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, is evidently inclined to it.[3] 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."[4]

[1] See "Liturgical Services of the Reign of Queen Eliz." (in Parker Soc. publ.), 569, 570.

[2] See his "Eccl. Memorials," iii., pt. i., 472; also his "Annals of the Ref.," ii., pt. ii., 151; and his "Life of Sir Thomas Smith," 161, 162.

[3] For Spottiswoode see "Hist. of the Church of Scotland" (Edin. reprint, 1851), i., 185, 186. For Bramhall see his "Works" (Oxford, 1844), iv., 60, 307, etc. For Jeremy Taylor see his "Sermons on the Life of Christ."

[4] For John Howe see his "Works" (Lond., 1862), 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's victory had been fairly won, 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."[1]

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 recognize 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."[2] Yet even as late as the last years of the

[1] See John Knox, "Historie of the Reformation of Religion within the Realm of Scotland" (Edin., 1732), lib. iv.; also Chambers, "Domestic Annals of Scotland," ii., 410–412.

[2] For Burton see "Anatomy of Melancholy," pt. ii., sect. 2. For Browne see his "Vulgar and Common Errors," ch. xiv.

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."[1] 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.

But it was in Germany and German Switzerland that this superstition took its 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 favor 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."[2] And sometimes he yielded to another phase of his belief, declared them works of the Devil, and declaimed against them as "harlot stars."[3]

Melanchthon, too, in various letters, declares comets to be heralds of heaven's wrath, classing them, with evil conjunctions of the planets and abortive births, among the "signs"

[1] See Thoresby's "Diary" (Lond., 1830), i., 132. Halley's great service is described further on in this chapter.

[2] For very striking examples of this mediæval terror in Germany see Von Raumer, "Geschichte der Hohenstaufen," vi., 538. For Reformation period see Wolf, "Gesch. d. Astronomie"; also Prætorius, "Ueber d. Comet-stern" (Erfurt, 1580), in which the above sentences of Luther are printed on the title-page as epigraphs.

[3] "Huren-Sternen." See the sermon of Celichius described later.

referred to in Scripture.[1] 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.[2] 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."[3] 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 vigor by Fromundus, the eminent professor and doctor of theology at the Catholic university of Louvain, who so strongly opposed the doctrine of the earth's rotundity. At the beginning of the seventeenth century, even so gifted an astronomer as Kepler yielded somewhat to the belief;[4] 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.[5]

Out of this belief was developed a great series of efforts to maintain the theological view of comets and to put down forever all efforts toward a scientific view. These efforts may be divided into two classes: those upon learned men and scholars, through the universities, and those upon people at large, through the pulpits. As to the first of these, that learned men and scholars might be kept in the paths of what was considered "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

[1] See Wolf, *ubi supra*.

[2] See Wolf, 235.

[3] See Mädler, "Geschichte der Himmelskunde," ii.

[4] For Kepler's superstition see Wolf, 230, 237.

[5] See Voigt, "Himmels-Magnaten Reichstage," Hamburg, 1676. For both Fromundus and Voigt see also Mädler, 399, and Lecky, "Rationalism in Europe," i., 28.

teaching that comets are heavenly bodies obedient to law.[1] 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 Tübingen, 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 school-master displaying the rod before naughty children.[2] A little later we have another churchman of great importance in that region—Schickhart, head pastor and superintendent at Göppingen—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."[3] 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."[4]

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 Tübingen 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

[1] For the effect of the anti-Pythagorean oath see Prowe, "Copernicus"; also Mädler and Wolf.

[2] See Heerbrand, "Von dem erschrockenlichen Wunderzeichen," Tübingen, 1577. [3] See Schickhart, "Predigt vom Wunderzeichen," Stuttgart, 1621.

[4] See Dieterich's sermon, described more fully below.

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 was an avowed Copernican, the pupil of Apian, 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.[1] 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 Tübingen 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 Leipzig law-student, Büttner. 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."[2]

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,

[1] See Maestlin, "Observatio et Demonstratio Cometæ," Tübingen, 1578.

[2] See Büttner, "Cometen Stundbüchlein," Leipzig, 1605.

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.[1]

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 recognized 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 cannot be stars, because new stars always betoken good, while comets betoken evil.[2]

The same teaching is seen in the Catholic universities of the Netherlands. Fromundus, at Louvain, in the middle of the seventeenth century led a crusade against all cometary heresy, upholding fully the prophetic attributes of comets.[3]

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

[1] See Vossius, "De Idololatria" (in his "Opera," v., 283–285).

[2] See Torreblanca, "De Magia," Seville, 1618, and often reprinted.

[3] See his "Meteorologica."

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 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 great, thick, and sticky, it blazes into a comet." And again he returns to the same view, saying that "one form of exhalation is thick, 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 every thing heavenly is eternal and incorruptible, but comets have a beginning and ending—*ergo*, comets cannot 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 mediæval method—the method which blots out an ascertained fact by means of a metaphysical doctrine—as opposed to the scientific and modern. 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.[1] He goes on into long disquisitions upon their colors, 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 treaty of 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 mediæval 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

[1] "*Barbata et caudata.*"

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.[1]

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 17th 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,

[1] See De Angelis, "Lectiones Meteorologicæ," Rome, 1673.

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.'" [1]

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 recognized 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 neighboring 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 vapor and mist, rising into the upper air and set ablaze by the celestial heat." Far more important for them is it to know what *is* this vapor and mist. It is really, in the opinion of Celichius, nothing more nor 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

[1] See Reinzer, "Meteorologia Philosophico-Politica" (ed. of Augsburg, 1712), 101–103.

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 proven 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."[1]

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 1620, 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

[1] See Celichius, as above.

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 St. 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 vapors, the thick, sticky, sulphurous clouds which rise from the earth toward heaven before God." Throughout the sermon contempt is poured over all men who simply investigate comets as natural objects, and special attention is called to a comet then in the heavens resembling a long broom or bundle of rods; and Dieterich 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. Conjuring 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.[1]

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 Zürich, 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

[1] "See "Ulmische Cometen-Predigt, von dem Cometen, so nechst abgewischen 1618 Jahrs im Wintermonat erstenmahls in Schwaben sehen lassen, . . . gehalten zu Ulm . . . durch Conrad Dieterich," Ulm, 1620. For a life of the author see article "Dieterich" in the "Allgemeine Deutsche Biographie." See also Wolf.

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.[1]

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."[2]

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.[3]

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,

[1] See Wolf, "Gesch. d. Astronomie," 239.

[2] See Grasser and Gross, "Christenliches Bedencken . . . von dem erschrockenlichen Cometen," etc., Zürich, 1664.

[3] See Spleiss, "Beiläuftiger Bericht von dem jetzigen Cometsternen," etc., Schaffhausen, 1664.

which appeared just before Mr. Cotton's sickness and disappeared after his death.[1] 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."[2] 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."[3]

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 colonies, 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."[4] 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

[1] See S. Danforth, "An Astronomical Description of the Late Comet or Blazing Star, Together with a Brief Theological Application Thereof," 1664.

[2] See Morton, "Memorial," 251, 252.

[3] *Ibid.*, 309, 310.

[4] Rev., viii., 10, and xi., 14.

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?" [1]

Vigorous as his 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." [2]

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 tendency 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

[1] See his "Heaven's Alarm to the World," Boston, 1682, and his "Discourse concerning Comets," Boston, 1682.

[2] See the "Manuductio," 54, 55.

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 Cæsar Scaliger protesting against the cometary superstition as "ridiculous folly."[1] Of more real importance was the treatise of Blaise de Vigenère 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 Vigenère 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

[1] For Scaliger see p. 20 of Dudith's book, cited below.

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.[1]

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.[2]

All these were denounced as infidels and heretics, yet not until they had set men at thinking and prepared 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

[1] For Blaise de Vigenère see his "Traité des Comètes," Paris, 1578. For Dudith see his "De Cometarum Significatione," Basle, 1579, to which the letter of Erastus is appended.

[2] Bekker's views may be found in his "Onderzoek van de Betekening der Cometen," Leeuwarden, 1683. For Lubienitzky's see his "Theatrum Cometicum," Amsterdam, 1666, in pt. ii.: "Historia Cometarum," preface "to the reader." For Petit see his "Dissertation sur la Nature des Comètes," Paris, 1665 (German transl., Dresden and Zittau, 1631).

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.[1] 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 persons 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 cannot 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." [2]

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[1] See Mädler, "Himmelskunde," 327.

[2] For special points of interest in Bayle's argument, see his "Pensées Diverses sur les Comètes," Amsterdam, 1749, pp. 79, 102, 134, 206. For the response to Jurieu, see the "Continuation des Pensées," Rotterdam, 1705; also Champion, 164, Lecky, *ubi supra*, and Guillemin, 29, 30.

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.[1]

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 honors of the victory.

For generations men in various parts of the world had been making various 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 take careful observations 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 noted 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 Tübingen, 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

[1] See Fontenelle, cited by Champion, 167.

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, and declared the doctrine of comets as "signs and wonders" a matter of faith.[1] They even brought forward some astronomers ambitious or wrong-headed enough to testify that Tycho and Kepler were wrong.[2]

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, cherished by the theologians, was that what lies within the moon's orbit appertains to the earth and is essentially transitory, while what lies beyond it belongs to the heavens and is permanent and regular. 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 neighborhood 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.

Attemps were 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. From the earliest times the theory favored by the Church was that the earth was surrounded by hollow spheres, concentric and transparent, forming a number of glassy strata encasing one another "like the different coatings of an onion," and that each one of these in its movement about the earth carries one of the heavenly bodies. Some maintained that these spheres were crystal;

[1] See Mädler, "Himmelskunde," i., 181, 197; also Wolf, "Gesch. d. Astronomie," and Janssen "Gesch. d. Deutschen Volkes," v., 350. Heerbrand's sermon, cited above, is a good specimen of the theologic attitude.

[2] See Pingré, ii., 81.

but Lactantius, and with him various Fathers of the Church, speak 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.[1]

Here we may pause for a moment to note one of the main 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.

How 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 labor not to test it, but to establish every part of 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, narrow and bigoted.

Various astronomers labored 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 moved in parabolic curves toward

[1] *Ibid.*, i., 89; Humboldt, "Cosmos" (Eng. translat., London, 1868), iii., 169.

the sun. Then came a man who developed this truth further—Samuel Doerfel; and it is a pleasure, as well as a duty, 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 and 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.[1]

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, recognized 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.[2] 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 tap-

[1] See Pingré, i., 53; Grant, "Hist. of Phys. Astron.," 305, etc., etc.

[2] For a curious partial anticipation by Hooke, in 1664, of the great truth announced by Halley in 1682, see Pepys' Diary for March 1st, 1664. For excellent summaries of the whole work of Halley and Clairaut and their forerunners and associates, see Pingré, Mädler, Wolf, Arago, *et al.*

estry 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 four centuries later to be, as Seneca had prophesied, a heavenly body obeying the great laws of the universe, and coming at regular periods.[1] Thenceforth the whole ponderous enginery of this superstition, with its citations of 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.[2]

It is instructive to note, when the main battle was lost, an 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 sci-

[1] In accordance with Halley's prophecy, the comet of 1682 has returned in 1759 and in 1835.

[2] See Mädler, Guillemin, Watson, Grant, Delambre, Proctor, art. "Astronomy," in "Encycl. Brit.," and especially, for details, Wolf, 407–412 and 701–722. For clear statement regarding Doerfel, see Wolf, 411.

ence" 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."[1]

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.[2]

[1] See T. Forster, "Illustrations of the Atmospherical Origin of Epidemic Diseases," Chelmsford, 1829, cited by Arago; also in *Quarterly Review* for April, 1835.

[2] For the writings of several on both sides, and especially of those who sought to save, as far as possible, the sacred theory of comets, see Mädler, ii., 384, *et seq.*, and Wolf, 186.

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 Leipzig 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 Leipzig in 1742, the agency of comets in the creation, the flood, and the final destruction of the world is fully proven.[1] 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.[2]

In our own country superstitious ideas regarding comets continued to have some little currency[3]; 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. In 1759 he published two lectures on comets, and in these he simply and clearly revealed the truth, never scoffing, but reasoning quietly and

[1] See Heyn, "Versuch einer Betrachtung uber die Cometen, die Sündfluth und das Vorspiel des jüngsten Gerichts," Leipzig, 1742. A Latin version, of the same year, bears the title, "Specimen Cometologiæ Sacræ."

[2] See Guillemin and Watson.

[3] See sermon of Israel Loring, of Sudbury, published in 1722.

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."[1]

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, to make ourselves sure of this. 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

[1] See Professor J. Winthrop on Comets.

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."

previous annual meeting, or the proposed amendment having received the approval of the Executive Council.

Amendment to the Constitution, April 25, 1886.

Resolved, To amend Article III. of the Constitution of the American Historical Association by striking out the words "twenty-five dollars" and introducing, in place thereof, "fifty dollars," as the regular life-membership fee of The American Historical Association, said amendment to go into effect January 1, 1887.

NOTE.—In view of the fact that members of the Association have not been generally notified of the passage of this amendment, in consequence of unavoidable delay in the issue of the present report, the Executive Council recommend provisionally that the date when the amendment shall take effect be June 1, 1887, instead of January 1, 1887, this recommendation to be submitted for ratification to the general Association at its fourth annual meeting.

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