

ORESME

ORESME, NICOLE (*b.* France, *ca.* 1320; *d.* Lisieux, France, 1382), *mathematics, natural philosophy.*

Oresme was of Norman origin and perhaps born near Caen. Little is known of his early life and family. In a document originally drawn in 1348, "Henry Oresme" is named along with Nicole in a list of masters of arts of the Norman nation at Paris. Presumably this is a brother of Nicole, for a contemporary manuscript¹ mentions a nephew of Nicole named Henricus *junior*. A "Guillaume Oresme" also appears in the records of the College of Navarre at Paris as the holder of a scholarship in grammar in 1352 and in theology in 1353; he is later mentioned as a bachelor of theology and canon of Bayeux in 1376.

Nothing is known of Nicole Oresme's early academic career. Apparently he took his arts training at the University of Paris in the 1340's and studied with the celebrated master Jean Buridan, whose influence on Oresme's writing is evident. This is plausible in that Oresme's name appears on a list of scholarship holders in theology at the College of Navarre at Paris in 1348. Moreover, in the same year he is listed among certain masters of the Norman nation, as was noted above. After teaching arts and pursuing his theological training, he took his theological mastership in 1355 or 1356; he became grand master of the College of Navarre in 1356.

His friendship with the dauphin of France (the future King Charles V) seems to have begun about this time. In 1359 he signed a document as "secretary of the king," whereas King John II had been in England since 1356 with the dauphin acting as regent. In 1360 Oresme was sent to Rouen to negotiate a loan for the dauphin.

Oresme was appointed archdeacon of Bayeux in 1361. He attempted to hold this new position together with his grand-mastership, but his petition to do so was denied and he decided to remain in Navarre. Presumably he left Navarre after being appointed canon at Rouen on 23 November 1362. A few months later (10 February 1363) he was appointed canon at Sainte-Chapelle, Paris, obtaining a semiprebend. A year later (18 March 1364) he was appointed dean of the cathedral of Rouen. He held this dignity until his appointment as bishop of Lisieux in 1377, but he does not appear to have taken up residency at Lisieux until 1380. From the occasional mention of him in university documents it is presumed that from 1364 to 1380 Oresme divided his time between Paris and Rouen, probably residing regularly in Rouen until 1369 and in Paris thereafter. From about 1369 he was busy translating certain Aristotelian Latin texts into French and writing commentaries on them. This was done at the behest of King Charles V, and his appointment as

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bishop was in part a reward for this service. Little is known of his last years at Lisieux.

Scientific Thought. The writings of Oresme show him at once as a subtle Schoolman disputing the fashionable problems of the day, a vigorous opponent of astrology, a dynamic preacher and theologian, an adviser of princes, a scientific popularizer, and a skillful translator of Latin into French.

One of the novelties of thought associated with Oresme is his use of the metaphor of the heavens as a mechanical clock. It has been suggested that this metaphor—which appears to mechanize the heavenly regions in a modern manner—arises from Oresme's acceptance of the medieval impetus theory, a theory that explained the continuance of projectile motion on the basis of impressed force or impetus. Buridan, Oresme's apparent master, had suggested the possibility that God could have impressed impetuses in the heavenly bodies, and that these, acting without resistance or contrary inclination, could continue their motion indefinitely, thus dispensing with the Aristotelian intelligences as the continuing movers. A reading of several different works of Oresme, ranging from the 1340's to 1377, all of which discuss celestial movers, however, shows that Oresme never abandoned the concept of the intelligences as movers, while he specifically rejected impetuses as heavenly movers in his *Questiones de celo*.² In these discussions he stressed the essential differences between the mechanics governing terrestrial motion and that involved in celestial motions. In two passages of his last work, *Livre du ciel et du monde d'Aristote*,³ he suggests (1) the possibility that God implanted in the heavens at the time of their creation special forces and resistances by which the heavens move continually like a mechanical clock, but without violence, the forces and resistances differing from those on earth; and (2) that "it is not impossible that the heavens are moved by a power or corporeal quality in it, without violence and without work, because the resistance in the heavens does not incline them to any other movement nor to rest but only [effects] that they are not moved more quickly." The latter statement sounds inertial, yet it stresses the difference between celestial resistance and resistance on the earth, even while introducing analogues to natural force and resistance. In other treatments of celestial motions Oresme stated that "voluntary" forces rather than "natural" forces are involved, but that the "voluntary" forces differ from "natural" ones in not being quantifiable in terms of the numerical proportionality theorems applicable to natural forces and resistances.⁴ In addition to his retention of intelligences as movers, a further factor prevents the identification of any of Oresme's treat-

ments of celestial movers with the proposal of Buridan. For Buridan, *impetus* was a thing of permanent nature (*res natura permanens*) which was corruptible by resistance and contrary inclination. But Oresme seems to hold in his *Questiones de celo*⁵ that impetus is not permanent, but is self-expending by the very fact that it produces motion. If this is truly what Oresme meant, it would be obviously of no advantage to use such impetuses in the explanation of celestial motions, for unless such impetuses were of infinite power (and he would reject this hypothesis for all such powers) they would have to be renewed continually by God. One might just as well keep the intelligences as movers. An even more crucial argument against the idea that Oresme used the impetus theory to explain heavenly motion is that he seems to have associated impetus with accelerated motion, and yet insisted on the uniform motion of the heavens. Returning to the clock metaphor, it should be noted that in the two places in which the metaphor is employed, Oresme did not apply it to the whole universe but only to celestial motions.

One of these passages in which the clock metaphor is cited leads into one of Oresme's most intriguing ideas—the probable irrationality of the movements of the celestial motions. The idea itself was not original with Oresme, but the mathematical argument by which he attempted to develop it was certainly novel. This argument occurs in his treatise *Proportiones proportionum* (“*The Ratios of Ratios*”). His point of departure in this tract is Thomas Bradwardine's fundamental exponential relationship, suggested in 1328 to represent the relationships between forces, resistances, and velocities in motions:

$$\frac{F_2}{R_2} = \left(\frac{F_1}{R_1}\right)^{\frac{v_2}{v_1}}$$

Oresme went on to give an extraordinary elaboration of the whole problem of relating ratios exponentially. It is essentially a treatment of fractional exponents conceived as “ratios of ratios.”

In this treatment Oresme made a new and apparently original distinction between irrational ratios of which the fractional exponents are rational, for example, $(\frac{2}{1})^{\frac{1}{2}}$, and those of which the exponents are themselves irrational, apparently of the form $(\frac{2}{1})^{\sqrt{1/2}}$. In making this distinction Oresme introduced new significations for the terms *pars*, *partes*, *commensurabilis*, and *incommensurabilis*. Thus *pars* was used to stand for the exponential part that one ratio is of another. For example, starting with the ratio $(\frac{2}{1})^{\frac{1}{2}}$, Oresme would say, in terms of his exponential calculus, that this irrational ratio is “one half part” of the ratio $\frac{2}{1}$ —

meaning, of course, that if one took the original ratio twice and composed a ratio therefrom, $\frac{2}{1}$ would result. Or one would say that the ratio $\frac{2}{1}$ can be divided into two “parts” exponentially, each part being $(\frac{2}{1})^{\frac{1}{2}}$, or more succinctly in modern representation:

$$\frac{2}{1} = \left[\left(\frac{2}{1}\right)^{\frac{1}{2}}\right]^2$$

Furthermore, Oresme would say that such a ratio as $(\frac{3}{1})^{\frac{2}{3}}$ is “two third parts” of $\frac{3}{1}$, meaning that if we exponentially divided $\frac{3}{1}$ into

$$\left(\frac{3}{1}\right)^{\frac{1}{3}} \cdot \left(\frac{3}{1}\right)^{\frac{1}{3}} \cdot \left(\frac{3}{1}\right)^{\frac{1}{3}}$$

then $(\frac{3}{1})^{\frac{2}{3}}$ is two of the three “parts” by which we compose the ratio $\frac{3}{1}$, again representable in modern symbols as

$$\left(\frac{3}{1}\right) = \left(\frac{3}{1}\right)^{\frac{2}{3}} \cdot \left(\frac{3}{1}\right)^{\frac{1}{3}}$$

This new signification of *pars* and *partes* also led to a new exponential treatment of commensurability. After this detailed mathematical treatment, Oresme claimed (without any real proof) that as we take a larger and larger number of the possible whole number ratios greater than one and attempt to relate them exponentially two at a time, the number of irrational ratios of ratios (that is, of irrational fractional exponents relating the pairs of whole number ratios) rises in relation to the number of rational ratios of ratios. From such an unproved mathematical conclusion, Oresme then jumps to his central theme, the implications of which reappear in a number of his works: it is probable that the ratio of any two unknown ratios, each of which represents a celestial motion, time, or distance, will be an irrational ratio. This then renders astrology—the predictions of which, he seems to believe, are based on the precise determinations of successively repeating conjunctions, oppositions, and other aspects—fallacious at the very beginning of its operations. A kind of basic numerical indeterminateness exists, which even the best astronomical data cannot overcome. It should also be noted that Oresme composed an independent tract, the *Algorism of Ratios*, in which he elucidated in an original way the rules for manipulating ratios.

Oresme's consideration of a very old cosmological problem, the possible existence of a plurality of worlds, was also novel. Like the great majority of his contemporaries, he ultimately rejected such a plurality in favor of a single Aristotelian cosmos, but before doing so he stressed in a cogent paragraph the possibility that God by His omnipotence could so create such a plurality.⁶

All heavy things of this world tend to be conjoined in one mass [*masse*] such that the center of gravity [*centre de pesanteur*] of this mass is in the center of this world, and the whole constitutes a single body in number. And consequently they all have one [natural] place according to number. And if a part of the [element] earth of another world was in this world, it would tend towards the center of this world and be conjoined to its mass. . . . But it does not accordingly follow that the parts of the [element] earth or heavy things of the other world (if it exists) tend to the center of this world, for in their world they would make a mass which would be a single body according to number, and which would have a single place according to number, and which would be ordered according to high and low [in respect to its own center] just as is the mass of heavy things in this world. . . . I conclude then that God can and would be able by His omnipotence [*par toute sa puissance*] to make another world other than this one, or several of them whether similar or dissimilar, and Aristotle offers no sufficient proof to the contrary. But as it was said before, in fact [*de fait*] there never was, nor will there be, any but a single corporeal world. . . .

This passage is also of interest in that it reveals Oresme's willingness to consider the possible treatment of all parts of the universe by ideas of center of gravity developed in connection with terrestrial physics.

The passage also illustrates the technique of expression used by Oresme and his Parisian contemporaries, which permitted them to suggest the most unorthodox and radical philosophical ideas while disclaiming any commitment to them.

The picture of Oresme's view of celestial physics and its relationship to terrestrial phenomena would not be complete without further mention of his well-developed opposition to astrology. In his *Questio contra divinatores* with *Quodlibeta annexa* we are told again and again that the diverse and apparently marvelous phenomena of this lower world arise from natural and immediate causes rather than from celestial, incorporeal influences. Ignorance, he claims, causes men to attribute these phenomena to the heavens, to God, or to demons, and recourse to such explanations is the "destruction of philosophy." He excepted, of course, the obvious influences of the light of the sun on living things or of the motions of celestial bodies on the tides and like phenomena in which the connections appear evident to observers. In the same work he presented a lucid discussion of the existence of demons. "Moreover, if the Faith did not pose their existence," he wrote, "I would say that from no natural effect can they be proved to exist, for all things [supposedly arising from them] can be saved naturally."⁷

In examining his views on terrestrial physics, we should note first that Oresme, along with many fourteenth-century Schoolmen, accepted the conclusion that the earth could move in a small motion of translation.⁸ Such a motion would be brought about by the fact that the center of gravity of the earth is constantly being altered by climatic and geologic changes. He held that the center of gravity of the earth strives always for the center of the world; whence arises the translatory motion of the earth. The whole discussion is of interest mainly because of its application of the doctrine of center of gravity to large bodies. Still another question of the motion of the earth fascinated Oresme, that is, its possible rotation, which he discussed in some detail in at least three different works. His treatment in the *Du ciel*⁹ is well known, but many of its essential arguments for the possibility of the diurnal rotation of the earth already appear in his *Questiones de celo*¹⁰ and his *Questiones de spera*.¹¹ These include, for example, the argument on the complete relativity of the detection of motion, the argument that the phenomena of astronomy as given in astronomical tables would be just as well saved by the diurnal rotation of the earth as by the rotation of the heavens, and so on. At the conclusion of the argument, Oresme says in the *Questiones de spera* (as he did in the later work): "The truth is, that the earth is not so moved but rather the heavens." He goes on to add, "However I say that the conclusion [concerning the rotation of the heavens] cannot be demonstrated but only argued by persuasion." This gives a rather probabilistic tone to his acceptance of the common opinion, a tone we often find in Oresme's treatment of physical theory. The more one examines the works of Oresme, the more certain one becomes that a strongly skeptical temper was coupled with his rationalism and naturalism (of course restrained by rather orthodox religious views) and that Oresme was influenced deeply by the probabilistic and skeptical currents that swept through various phases of philosophy in the fourteenth century. He twice tells us in the *Quodlibeta* that, except for the true knowledge of faith, "I indeed know nothing except that I know that I know nothing."¹²

In discussing the motion of individual objects on the surface of the earth, Oresme seems to suggest (against the prevailing opinion) that the speed of the fall of bodies is directly proportional to the time of fall, rather than to the distance of fall, implying as he does that the acceleration of falling bodies is of the type in which equal increments of velocity are acquired in equal periods of time.¹³ He did not, however, apply the Merton rule of the measure of uniform acceleration of velocity by its mean speed, discovered at Oxford in the

1330's, to the problem of free fall, as did Galileo almost three hundred years later. Oresme knew the Merton theorem, to be sure, and in fact gave the first geometric proof of it in another work, but as applied to uniform acceleration in the abstract rather than directly to the natural acceleration of falling bodies. In his treatment of falling bodies, despite his different interpretation of *impetus*, he did follow Buridan in explaining the acceleration of falling bodies by continually accumulating impetus. Furthermore, he presented (as Plutarch had done in a more primitive form) an *imaginatio*—the device of a hypothetical, but often impossible, case to illustrate a theory—of a body that falls through a channel in the earth until it reaches the center. Its impetus then carries it beyond the center until the acquired impetus is destroyed, whence it falls once more to the center, thus oscillating about the center.¹⁴

The mention of Oresme's geometrical proof of the Merton mean speed theorem brings us to a work of unusual scope and inventiveness, the *Tractatus de configurationibus qualitatum et motuum*, composed in the 1350's while Oresme was at the College of Navarre. This work applies two-dimensional figures to hypothetical uniform and nonuniform distributions of the intensity of qualities in a subject and to equally hypothetical uniform and nonuniform velocities in time.

There are two keys to our proper understanding of the *De configurationibus*. To begin with, Oresme used the term *configuratio* in two distinguishable but related meanings, that is, a primitive meaning and a derived meaning. In its initial, primitive meaning it refers to the fictional and imaginative use of geometrical figures to represent or graph intensities in qualities and velocities in motions. Thus the base line of such figures is the subject when discussing linear qualities or the time when discussing velocities, and the perpendiculars raised on the base line represent the intensities of the quality from point to point in the subject, or they represent the velocity from instant to instant in the motion (Figs. 1–4). The whole figure, consisting of all the perpendiculars, represents the whole distribution of intensities in the quality, that is, the quantity of the quality, or in case of motion the so-called total velocity, dimensionally equivalent to the total space traversed in the given time. A quality of uniform intensity (Fig. 1) is thus represented by a rectangle, which is its *configuratio*; a quality of uniformly nonuniform intensity starting from zero intensity is represented as to its configuration by a right triangle (Fig. 3), that is, a figure where the slope is constant ($GK/EH = CK/GH$). Similarly, motions of uniform velocity and uniform acceleration are represented,

respectively, by a rectangle and a right triangle. There is a considerable discussion of other possible configurations.

Differences in configuration—taken in its primitive meaning—reflect for Oresme in a useful and suitable fashion internal differences in the subject. Thus we can say by shorthand that the external configuration represents some kind of internal arrangement of intensities, which we can call its essential internal *configuratio*. So we arrive at the second usage of the term configuration, in which the purely spatial or geometrical meaning is abandoned, since one of the variables involved (namely intensity) is not essentially spatial, although, as Oresme tells us, variations in intensity can be represented by variations in the length of straight lines. He suggests at great length how differences in internal configuration may explain many physical and even psychological phenomena, which are not simply explicable on the basis of the primary elements that make up a body. Thus two bodies might have the same amounts of primary elements in them and even in the same intensity, but the configuration of their intensities may well differ, and so produce different effects in natural actions.

The second key to the understanding of the configuration doctrine of Oresme is what we may call the suitability doctrine. It pertains to the nature of configurations in their primitive meaning of external figures and, briefly, holds that any figure or configuration is suitable or fitting for description of a quality, when its altitudes (ordinates, we would say in modern parlance) on any two points of its base or subject line are in the same ratio as the intensities of the quality at those points in the subject. The phrase used by Oresme to describe the key relationship of intensities and altitudes occurs at the beginning of Chapter 7 of the first part, where he tells us that:

Any linear quality can be designated by every plane figure which is imagined as standing perpendicularly on the linear extension of the quality and which is proportional in altitude to the quality in intensity. Moreover a figure erected on a line informed with a quality is said to be "proportional in altitude to the quality in intensity" when any two lines perpendicularly erected on the quality line as a base and rising to the summit of the surface or figure have the same ratio to each other as do the intensities at the points on which they stand.

Thus, if you have a uniform linear quality, it can be suitably represented by every rectangle erected on the given base line designating the extension of the subject (for example, either *ADCB* or *AFEB*, or any other rectangle on *AB* in Fig. 1), because any rectangle on that base line will be "proportional in altitude to the

$$\frac{MK}{IG} = \frac{LK}{HG} = 1$$

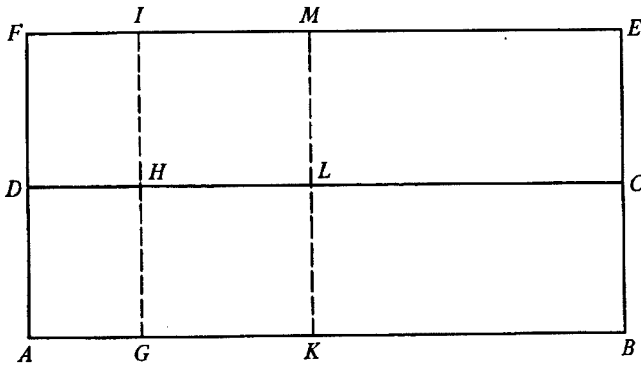


FIGURE 1

quality in intensity," the ratio of any two intensities always being equal to one (that is, $MK/IG = LK/HG = 1$). Similarly, a uniformly difform quality will be represented by every right triangle on the given base line, since two altitudes on any one right triangle will have the same ratio to each other as the corresponding two altitudes over the same points of the base line of any other triangle (that is, in Fig. 2, $DB/FE = CB/GE$).

$$\frac{DB}{FE} = \frac{CB}{GE}$$

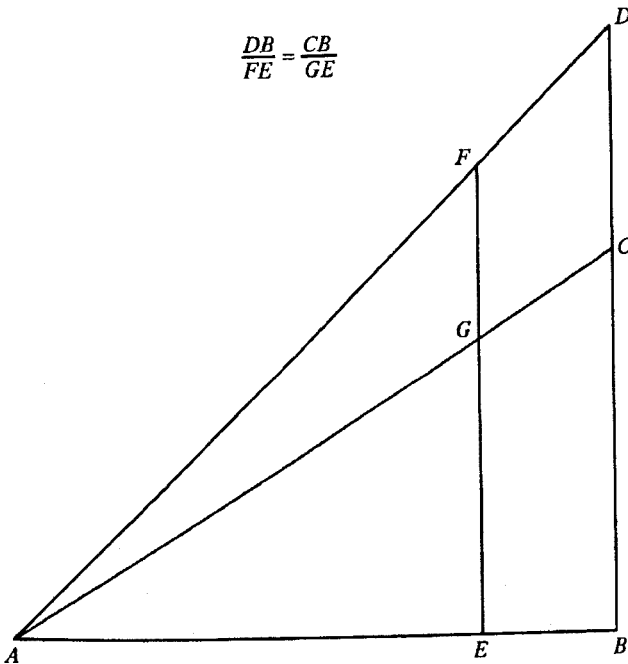


FIGURE 2

The only proviso is, of course, that when we compare figures—say, one uniform quality with another—we must retain some specific figure (say rectangle) as the point of departure for the comparison. Thus, in representing some uniform quality that is twice as

intense as the first one, we would have a rectangle whose altitude is everywhere twice as high as that of the rectangle specifying the first uniform quality.

The essential nature of this suitability doctrine was not present in the *Questiones super geometriam Euclidis*, and in fact it is specifically stated there that some specific quality must be represented by a specific

$$\frac{GK}{EH} = \frac{CK}{GH}$$

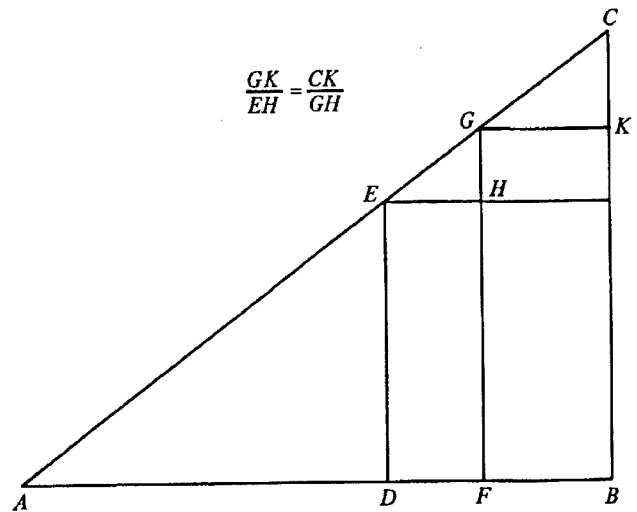


FIGURE 3

figure rather than a specific kind of figure; that is, a quality represented by a semicircle (Fig. 4) is representable only by that single semicircle on the given base line. But in the *De configurationibus* (pt. 1, ch. 14) Oresme decided in accordance with his fully developed suitability doctrine that such a quality that is representable by a semicircle can be represented by any curved

$$\frac{CD}{EF} = \frac{HD}{FG} = \frac{JD}{IF}$$

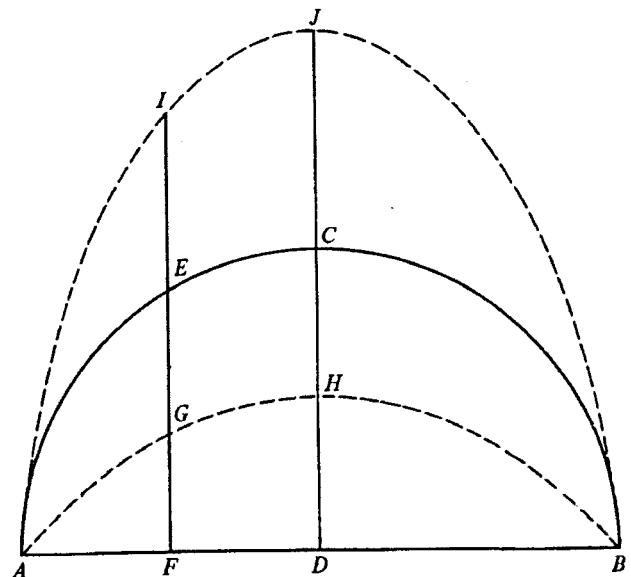


FIGURE 4

figure on the same base whose altitudes (ordinates) would have any greater or lesser constant ratio with the corresponding altitudes (ordinates) of the semicircle (for example, in Fig. 4, $CD/EF = HD/FG = JD/IF$). He was puzzled as to what these higher or lower figures would be. For the figures of higher altitudes, he definitely rejected their identification with segments of circles, and he said he would not treat the figures of lower altitudes. Unfortunately, Oresme had little or no knowledge of conic sections. In fact the conditions he specified for these curves comprise one of the basic ways of defining ellipses: if the ordinates of a circle $x^2 + y^2 = a^2$ are all shrunk (or stretched) in the same ratio b/a , the resulting curve is an ellipse whose equation is $x^2/a^2 + y^2/b^2 = 1$. Oresme, without realizing it, has given conditions that show that the circle is merely one form of a class of curves that are elliptical. It is quite evident that Oresme arrived at the conclusion of this chapter by systematically applying the basic and sole criterion of suitability of representation, which he has already applied to uniform and uniformly difform qualities; namely, "that the figure be proportional in altitude to the quality in intensity," which is to say that any two altitudes on the base line have the same ratios as the intensities at the corresponding points in the subject. He had not adequately framed this doctrine in the *Questiones super geometriam Euclidis*, and in fact he denied it there, at least in the case of a quality represented by a semicircle or of a uniform or uniformly difform quality formed from such a difform quality. In this denial he confused the question of sufficiently representing a quality and that of comparing one quality to another.

While the idea of internal configuration outlined in the first two parts of the book had little effect on later writers and is scarcely ever referred to, the third part of the treatise—wherein Oresme compared motions by the external figures representing them, and particularly where he showed (Fig. 5) the equality of a right triangle representing uniform acceleration with a rectangle

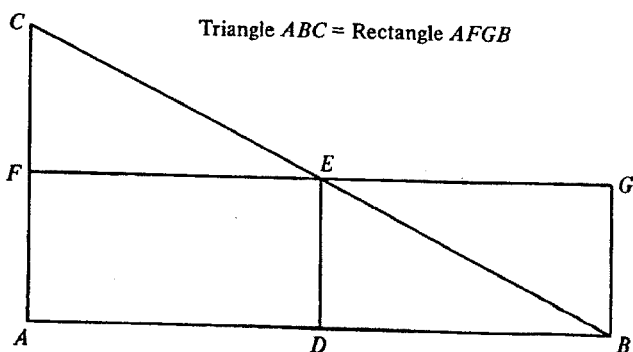


FIGURE 5

representing a uniform motion at the velocity of the middle instant of acceleration—was of profound historical importance. The use of this equation of figures can be traced successively to the time of its use by Galileo in the third day of his famous *Discorsi* (Theorem I). And indeed the other two forms of the acceleration law in Galileo's work (Theorem II and its first corollary) are anticipated to a remarkable extent in Oresme's *Questiones super geometriam Euclidis*.¹⁵

The third part of the *De configurationibus* is also noteworthy for Oresme's geometric illustrations of certain converging series, as for example his proof in chap. 8 of the series

$$1 + \frac{1}{2} \cdot 2 + \frac{1}{4} \cdot 3 \cdots + \frac{1}{2^{n-1}} \cdot n \cdots = 4.$$

He had showed similar interest in such a series in his *Questions on the Physics* and particularly in his *Questiones super geometriam Euclidis*. In the latter work he clearly distinguished some convergent from divergent series. He stated that when the infinite series is of the nature that to a given magnitude there are added "proportional parts to infinity" and the ratio a/b determining the proportional parts is less than one, the series has a finite sum. But when $a > b$, "the total would be infinite," that is, the series would be divergent. In the same work he gave the procedure for finding the following summation:

$$1 + \frac{1}{3} + \frac{1}{9} + \frac{1}{27} + \cdots + \frac{1}{3^n} + \frac{1}{3^{n+1}} + \cdots = \frac{3}{2}.$$

In doing so, he seems to imply a general procedure for the summation of all series of the form:

$$1 + \frac{1}{m} + \frac{1}{m^2} + \frac{1}{m^3} + \cdots + \frac{1}{m^n} + \frac{1}{m^{n+1}} + \cdots$$

His general rule seems to be that the series is equal to y/x when, $(1/m^t - 1/m^{t+1})$ being the difference of any two successive terms,

$$m^t \left(\frac{1}{m^t} - \frac{1}{m^{t+1}} \right) = \frac{x}{y}.$$

As we survey Oresme's impressive accomplishments, it is clear that his natural philosophy lay within the broad limits of an Aristotelian framework, yet again and again he suggests subtle emendations or even radical speculations.

NOTES

1. MS Paris, BN lat. 7380, 83v; cf. MS Avranches, Bibl. Munic. 223, 348v.
2. Bk. II, quest. 2.

3. Menut text, 70d–71a; 73d.
4. *Questiones de spera*, quest. 9; *Questiones de celo*, bk. II, quest. 2.
5. Bk. II, quest. 13.
6. *Du ciel*, 38b, 39b–c.
7. MS Paris, BN lat. 15126, 127v.
8. *Questiones de spera*, quest. 3.
9. 138b–144c; see also Clagett, *Science of Mechanics*, 600–608.
10. Bk. II, quest. 13.
11. Quest. 6[8]; see also Clagett, *Science of Mechanics*, 608, n. 23.
12. BN lat. 15126, 98v, 118v.
13. *Questiones de celo*, bk. II, quest. 7.
14. *Questiones de celo*, *ibid.*; *Du ciel*, 30a–b; Clagett, *Science of Mechanics*, 570.
15. Clagett, *Nicole Oresme and the Medieval Geometry of Qualities, etc.*, ch. 2, pt. A.

BIBLIOGRAPHY

I. ORIGINAL WORKS. Oresme's scholarly writings reflect a wide range of interests and considerable originality. He was the author of more than thirty different writings, the majority of which are unpublished and remain in manuscript. They can be conveniently grouped into five categories:

1. Collections of, or individual, *questiones*. These include questions on various works of Aristotle: *Meteorologica* (perhaps in two versions, with MS St. Gall 839, 1–175v being the most complete MS of the vest version); *De sensu et sensato* (MS Erfurt, Amplon. Q. 299, 128–157v); *De anima* (MSS Bruges 514, 71–111v; Munich, Staatsbibl. Clm 761, 1–40v; a different version with an *expositio* in Bruges 477, 238v–264r, may also be by Oresme); *De generatione et corruptione* (MS Florence, Bibl. Naz. Centr., Conv. Soppr. H. ix. 1628, 1–77v; a different version in MS Vatican lat. 3097, 103–146; and Vat. lat. 2185, 40v–61v, may be by him); *Physica* (MS Seville, Bibl. Colomb. 7–6–30, 2–79v); and *De celo* (MSS Erfurt, Amplon. Q. 299, 1–50; Q. 325, 57–90). These also include questions on the *Elementa* of Euclid (edit. of H. L. L. Busard [Leiden, 1961]; additional MS Seville, Bibl. Colomb. 7–7–13, 102v–112) and on the *Sphere* of Sacrobosco (MSS Florence, Bibl. Riccard. 117, 125r–135r; Vat. lat. 2185, 71–77v; Venice Bibl. Naz. Marc. Lat. VIII, 74, 1–8; Seville, Bibl. Colomb. 7–7–13; a different version is attributed to him in Erfurt, Amplon. Q. 299, 113–126). There are other individual questions that are perhaps by him: *Utrum omnes impressiones* (MS Vat. lat. 4082, 82v–85v; edit. of R. Mathieu, 1959), *Utrum aliqua res videatur* (MS Erfurt, Amplon. Q. 231, 146–150), *Utrum dyiameter alicuius quadrati sit commensurabilis coste eiusdem* (MS Bern A. 50, 172–176; H. Suter, ed., 1887; see *Isis*, 50 [1959], 130–133), and *Questiones de perfectione specierum* (MS Vat. lat. 986, 125–133v). This whole group of writings seems to date from the late 1340's and early 1350's, that is, from the period when Oresme was teaching arts.

2. A group of mathematico-physical works. This includes a tract beginning *Ad pauca respicientes* (E. Grant, ed., 1966), which is sometimes assigned the title *De*

motibus sperarum (MS Brit. Mus. 2542, 59r); a *De proportionibus proportionum* (E. Grant, ed. [Madison, Wisc., 1966]); *De commensurabilitate sive incommensurabilitate motuum celi* (E. Grant, ed. [Madison, Wisc., 1971]); *Algorismus proportionum* (M. Curtze, ed. [Thorn, 1868], and a partial ed. by E. Grant, thesis [Wisconsin, 1957]); and *De configurationibus qualitatum et motuum* (M. Clagett, ed. [Madison, Wisc., 1968]). These works also probably date from the period of teaching arts, although some may date as late as 1360.

3. A small group of works vehemently opposing astrology and the magical arts. Here we find a *Tractatus contra iudicarios astronomos* (H. Pruckner, ed., 1933; G. W. Coopland, ed., 1952); a somewhat similar but longer exposition in French, *Le livre de divinacions* (G. W. Coopland, ed., 1952); and a complex collection commonly known as *Questio contra divinatores* with *Quodlibeta annexa* (MS Paris, BN lat. 15126, 1–158; Florence, Bibl. Laurent. Ashb. 210, 3–70v; the *Quodlibeta* has been edited by B. Hansen in a Princeton University diss. of 1973). The first two works almost certainly date before 1364; the last is dated 1370 in the manuscripts but in all likelihood is earlier.

4. A collection of theological and nonscientific works. This includes an economic tract *De mutationibus monetarum* (many early editions; cf. C. Johnson, ed. [London, 1956]; this work was soon translated into French, cf. E. Bridrey's study), a *Commentary on the Sentences of Peter Lombard* (now lost but referred to by Oresme); a short theological tract *De communicatione ydiomatum* (E. Borchert, ed., 1940); *Ars sermonificandi, i.e.*, on the preaching art (MSS Paris, BN lat. 7371, 279–282; Munich, Clm 18225); a short legal tract, *Expositio cuiusdam legis in resumpta in domo Navarre* (MS Paris, BN lat. 16535, 111–114v); a tract predicting bad times for the Church, *De malis venturis super Ecclesiam* (Paris, BN 14533, 77–83v); a popular and oft-published *Sermo coram Urbano V* (delivered in 1363; Flaccus Illyricus, ed. [Basel, 1556; Lyons, 1597]), a *Decisio an in omni casu* (possibly identical with a *determinatio* in MS Brussels, Bibl. Royale 18977–81, 51v–54v); a *Contra mendicacionem* (MSS Munich, Clm 14265; Kiel, Univ. Bibl. 127; Vienna, Nat.-bibl. 11799); and finally some 115 short sermons for Sundays and Feast Days, *Sacre conciones* (Paris, BN lat. 16893, 1–128v). The dating of this group is no doubt varied, but presumably all of them except the *Commentary on the Sentences* postdate his assumption of the grand-mastership at Navarre.

5. A group of French texts and translations. This embraces a popular tract on cosmology, *Traité de l'esperance* (L. M. McCarthy, ed., thesis [Toronto, 1943]), which dates from about 1365; a translation and commentary, *Le livre de ethiques d'Aristote* (A. D. Menut, ed., [New York, 1940]), completed in 1372; a similar translation and commentary of the *Politics*—*Le livre de politique d'Aristote* (Vérard, ed. [Paris, 1489; cf. Menut's ed., in *Transactions of the American Philosophical Society*, n.s. 60, pt. 6 (1970)]), completed by 1374; the *Livre de ycono-*

mique d'Aristote (Vérard, ed. [Paris, 1489]; A. D. Menut, ed. [Philadelphia, 1957]), completed about the same time; and finally, *Livre du ciel et du monde d'Aristote* (A. D. Menut and A. J. Denomy, eds. [Toronto, 1943], new ed., Madison, Wisc., 1968), completed in 1377. To these perhaps can be added a translation of *Le Quadripartit de Ptholomee* (J. F. Gossner, ed., thesis [Syracuse, 1951]), although it is attributed to G. Oresme.

6. Modern editions. These comprise "De configurationibus qualitatum et motuum," in M. Clagett, ed., *Nicole Oresme and the Medieval Geometry of Qualities* (Madison, Wisc., 1968); E. Grant, ed., "De proportionibus proportionum" and "Ad pauca respicientes" (Madison, Wisc., 1966); *Nicole Oresme and the Kinematics of Circular Motion* (Madison, Wisc., 1971); A. D. Menut, ed., *Le livre de ethiques d'Aristote* (New York, 1940); A. D. Menut and M. J. Denomy, eds., *Le livre de ciel et du monde d'Aristote*, in *Mediaeval Studies*, 3-5 (1941-1943), rev. with English trans. by Menut (Madison, Wisc., 1968).

II. SECONDARY LITERATURE. Only a brief bibliography is given here because the extensive literature on Oresme appears in full in the editions of Grant, Clagett, and Menut listed above. These editions include full bibliographical references to the other editions mentioned in the list of Oresme's works.

Works on Oresme include E. Borchert, "Die Lehre von der Bewegung bei Nicolaus Oresme," in *Beiträge zur Geschichte der Philosophie und Theologie des Mittelalters*, 31, no. 3 (1934); M. Clagett, *The Science of Mechanics in the Middle Ages* (Madison, Wisc., 1959, 1961); M. Curtze, *Die mathematischen Schriften des Nicole Oresme (ca. 1320-1382)* (Berlin, 1870); P. Duhem, *Études sur Léonard de Vinci*, 3 vols., (Paris, 1906-1913); *Le système du monde*, VI-X (Paris, 1954-1959). See also the following works by A. Maier, *An der Grenze von Scholastik und Naturwissenschaft*, 2nd ed. (Rome, 1952); *Die Vorläufer Galileis im 14. Jahrhundert* (Rome, 1949); *Zwei Grundprobleme der scholastischen Naturphilosophie*, 2nd ed. (Rome, 1952); and O. Pederson, *Nicole Oresme, og hans Naturfilosofiske System. En undersøgelse af hans skrift "Le livre du ciel et du monde"* (Copenhagen, 1956).

MARSHALL CLAGETT

ORIBASIUS (*fl.* Pergamum, fourth century), *medicine*.

The life of Oribasius (or Orebasius, the correct form of his name is not certain) is described by Eunapius in his *Lives of the Philosophers and Sophists*. This article follows Schröder's presentation, which is based on Eunapius and other sources. Since Oribasius is mentioned among the Sophists, he was an "iatrosophist"—a concept which appeared before the fourth century and which referred to a physician of a particular rhetorical and philosophical orientation.¹ He came from a prominent family in Pergamum, where he was born at the beginning of the fourth century. He may have studied medicine there, but

most of his medical education was obtained at Alexandria. In the late Hellenistic period the study of medicine at Alexandria had become "scholastic," as Galen termed it—it was divorced from practice and was purely theoretical.² Oribasius, however, dissociated himself from physicians who were overly concerned with rhetoric and philosophy.

In Pergamum, Oribasius belonged to the circles representing the intellectual elite of the age; there he met the future Emperor Julian the Apostate, who later made Oribasius his physician in ordinary and head of his library. The relationship between the two plainly was very close, and Oribasius' political influence was correspondingly great. He also was a political official, quaestor of Constantinople. In addition he was closely associated with the emperor's cultural program, including the restoration of pagan religion. Oribasius' notes (a *hypomnema*) on the emperor's life have not survived, but they served as an essential source for Eunapius' biography of Julian and, evidently, as a source for some parts of the historical writings of Ammianus Marcellinus. Banished after Julian's death along with other of his supporters, Oribasius was later rehabilitated. He was married and had four children; a son named Eustathius was also a physician.

The initial stimulus for Oribasius' work as a medical writer was a suggestion by Julian that he prepare abstracts (*epitomai*) of Galen's works; this composition has not survived. His most extensive surviving work (although it was not transmitted intact) is *Iatrikai synagogai* (or *Collectiones medicae*), which contains excerpts from the writings of the more important Greek physicians. These extracts are primarily, but not entirely, verbatim.³ From this large work he produced *Synopsis for Eustathius* (also extant), a kind of abridged edition or vade mecum for his son. There still exists *For Eunapius*, a collection of easily procured medicines compiled for the layman. The known lost works, in addition to the historical account already mentioned, are *To the Perplexed Physicians*, *On Diseases*, *Anatomy of the Intestines*, and, outside the field of medicine, *On Royal Rule* (only the title of the last work is known). Two spurious writings are extant: *Introductions to Anatomy* and a commentary on the *Aphorisms of Hippocrates*. (The authorship of the commentary, which is preserved only in Latin translation, should be carefully examined since it contains material of interest for the history of medicine.)⁴

Oribasius' encyclopedic medical writings became the model for such authors as Aëtius of Amida. They also found a large audience in the Latin West, as the early (fifth century [?]) Latin translations of