SQUARING THE CIRCLE: AN EXAMINATION OF SCIENTIFIC IDEAS IN JAMES JOYCE'S ULYSSES

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ABSTRACT

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Science appears in James Joyce's Ulysses as both technology and paradigm. Behind all the technology and inventions in the novel lies a distintegrating cosmology which, rather than functioning as a credible metaphor, is slowly sinking back to myth. Joyce portrays the transition from the static and harmonious Enlightenment world to the dynamic and unstable modern one through concepts such as entropy and degeneration, and through an analogy between this modern disintegration and the dissolution of the Mediaeval world which occurred with the rise of the new science in the Renaissance. In his comic debunking of the Newtonian and Darwinian models of man, nature, and God, Joyce has all change (parallaxis) recall magical and superstitious ancient Greece where science began. The squaring of the circle, a problem already known in ancient Greece, functions as the labyrinthine thread of the novel, the major image through which are depicted all attempts to reunite the finite and infinite, the concrete and abstract, which science separated. The visual means for effecting this union is the dissolution of parallax. In Ulysses, however, parallax is not dissolved, nor the circle squared.

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Introduction

All literature is dependent upon, although not interchangeable with, the leading ideas of its time. This is the case even when the theory governing its creation explicitly denies this connection in an attempt to remove the poem or novel from contemporary external influences and to make of the Book a world of its own. This is not to say that a poem or novel is not in fact a self-contained world, but merely that literature is always more or less closely related to life. Even the theory which would make art as irrelevant or "useless" as possible is based upon contemporary ideas concerning the function of art. Thus, for example, the method for unfolding the central image in a symbolist poem indicates a preoccupation with technique; this preoccupation with method may itself originate in a general atmosphere of technology, an area at first glance distantly removed from a theory of poetry which purports to make of the poem a temple of art.

However, ideas may be expressed more directly as part of the work's subject matter and through structure, metaphor, and imagery. This is clearly the case in James Joyce's Ulysses. That Ulysses, a modern epic delineating the movement or "gesture" of the preceding 2000 years of western civilization should ignore what was probably the most significant event of those millenia—is unlikely. In

fact, science and its powerful method are parodied; but are never ignored; they function both as subject matter and as metaphor in the novel. Science is found not only in the Ithaca episode, explicitly devoted to science, but also as a leit-motif throughout the other episodes.

Because science by Bloomsday had become the primary source of verifiable knowledge, any reconciliation between Bloom, Stephen, and Molly, if it is to occur, must be effected through a scientific metaphor. Science, which itself helped entrench the dualism between the spiritual and physical realities by banishing to the realm of uncertainty all questions of immortality, freedom, and God, therefore becomes the major vehicle in the attempt to unite these perspectives. The paradigm for the resolution of the spiritual and physical duality is the squaring of the circle; that for the unification of the two fundamentally different modes of cognition is the identity of the syllogism and the dialectic; that for gaining a unitary metaphysics connecting the human mind to the physical universe is the blending of the two fundamental features of reality, space and time, into a new, scientifically valid space-time unity.

In none of these instances is the unification effected through a scientific metaphor; over and over again, Joyce demonstrates that the only access to such a unification is individual, isolated, incommunicable mysticism. This mysti-

cism, whether religious or epistemological, cannot, because it is irrational, yield anything scientifically valid. In the Circe episode, the squared circle, used as the basis for the construction of the New Jerusalem, results only in the kidney-shaped New Bloomusalem; in Ithaca, the "secular", that is, algebraic, solution is equally ineffective. In Circe, Stephen's attempt to abolish space and time results only in a momentary darkening of the universe or brothel; in Ithaca, space and time do not become a new unity, but are left merely as a restatement of Zeno's paradox. In both episodes, at the crucial moment, parallax remains undissolved. Thus, in Circe and in Ithaca occur the only two occasions during which there is a possibility for attaining a reconciliation of all that Bloom and Stephen individually represent. In Circe, the attempt occurs through the unconscious, through intuition or "female logic", in Ithaca through an incomplete scientific method. The result in the first instance is a parody of religious mysticism or deliverance, a hallucination; in the second, it is a parody of scientific knowledge. The episodes remain mirror images of themselves and of each other, "quadruple existences".

That these attempts at resolving essentially incompatible ways of seeing and knowing the world are intended to be extended through the characters to the temper of the times is indicated by Joyce's couching of the problem within the

mediaeval disciplines of the trivium (grammar, logic, rhetoric) and quadrivium (arithmetic, geometry, music, astronomy), the former represented by Stephen, the latter by Bloom. The stable theological and philosophical world view that resulted from the unification of the seven arts in the ideal mediaeval education was destroyed, at least in part, by the rise of science or the quadrivial arts to prominence. The resulting scientific world view which culminated in the Newtonian cosmos is shown in Ulysses to be itself disintegrating in the face of unresolved difficulties. It is the disintegration in each instance that makes the two situations analogous. The difference in the modern version is that because science had come so thoroughly to dominate the humanities, verifiable change could only occur through science. For this reason, the Ithaca episode takes precedence over the others.

The carrier of scientific and pseudo-scientific notions is, of course, Leopold Bloom. As an advertising canvasser, however, Bloom is closer to technology than to pure science. In a way, the relationship between technology and science is analogous to that between advertising and rhetoric or that between journalism and literature. Scientific technology, advertising, and journalism are lower forms (or technologies) of their parent arts, appealing to the "mass mind" and allowing that mind to participate in the par-

ent art no matter how indirectly. However, this is true only insofar as parent and child remain connected. In Ulysses, these are parting company and, although technology is supposed to offer comforts to its beneficiaries, when it is separated from an understanding of the principles underlying it, it cannot compensate the ordinary man for what he has lost—a comprehensible sense of the world, with the concommittant loss of control that this entails. Thus, Bloom has difficulty understanding and remembering Archimedes' principle, or any other principle for that matter. Nevertheless, he has a yearning to make sense of the universe, and he tries to do this through science.

The scientific principles through which Bloom tries to explain the world to himself and to others together constitute a microcosmic history of science. They demonstrate the consequences of the scientific way of seeing the world upon epistemology and upon the psychology of scientific man, the first through the paradigms to which they are referred, the second through their effects upon the three major characters, Bloom primarily.

There are two scientific paradigms in Ulysses: the Newtonian and its method, and the Darwinian, along with their extensions into other areas of the world. Much of the novel functions around the latter replacing the former. This replacement of an essentially spatial and static Enlighten-

ment science by a time-dependent or dynamic science is demonstrated most explicitly in Bloom's meditations, first on astronomy, then on biology, in the Ithaca episode. However, their respective relationships to space and time enable these paradigms to be extended to every other episode in the novel, with the possible exception of Penelope. Richard Ellmann, for example, has categorized the 18 episodes by their relationship to space and time.[1] Another way of interpreting this connection is in relation to sight, the spatial faculty, or to sound and touch, the faculties of time and secondary measurement, as Marshall McLuhan has done.[2] That Joyce considered these two paradigms or ways of seeing the world fundamentally incompatible is demonstrated in his use of the device of parallax, at once a word referring to sight, measurement, and space, and to change or time.

However, the novel depicts not simply a replacement of Newton's harmonious cosmos by Darwin's "dog eat dog" evolutionary progress. Certain scientific developments which indicated that the sun was losing its energy and that the earth was cooling down created difficulties for the Darwinian

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[1]Richard Ellmann, Ulysses on the Liffey (New York: Oxford University Press, 1973), p.19.

[2]Marshall McLuhan, "James Joyce: Trivial and Quadrivial," in Eugene McNamara, ed., The Interior Landscape: The Literary Criticism of Marshall McLuhan (New York: McGraw-Hill, 1969), pp.23-47.

view of development; this, coupled with archaeological discoveries of ancient civilizations which had declined and disappeared, led in the latter part of the 19th century to a momentary reversal of Darwinian evolution, and encouraged degenerationist notions of human and cultural development.

Thus, it was possible to believe not only that the world was coming to an end, albeit ever so slowly, an encouragement to apocalyptic visions, but also that what was the case in science was by analogy—and by observation—the case in Europe at the end of the 19th century. Science, therefore, lent credence to cyclical theories of culture and history which were extended to literature. The most prominent sign of uncertainty about human origins and about knowledge in general was an increase in mysticism and superstition.

Confusion in science gave an impetus to mysticism. Any explanation based upon unquantifiable process rather than on discrete quantifiable atoms is not only non-science but is also liable to charges of mysticism because one thing becomes indistinguishable from another. This "melting" was most clearly seen in the biological romanticism of the end of the century in such concepts as élan vital and entelechy which either raise the "life force" into a process to be grasped by intuition or make of form a teleological explanation of development. In Ulysses, this state of mind is portrayed in

Bloom's meditation on Pi in the Ithaca episode, in the importance that Stephen attaches to entelechy and to discovering the "Word", and in the entire question of the "consubstantiation" of the mystical trinity, Bloom, Stephen, Molly.

Furthermore, modern scientific paradigms can be extended in Ulysses back to the ancient controversy over atoms and process, and it is this kind of analogy which ties the end of the cycle to the beginning, Joyce's Dublin to Homer's Greece, both lying in magic and mysticism. Ulysses, thus, is not a narrative or history but a description of ideas which, while they may have taken as long as 2000 years to develop to their Bloomsday condition, are somehow simultaneous. This paradoxical situation is the result of Joyce's cyclical view of time and history, a view based not upon exact recurrence but upon (the reader's recognition of) similarity and analogy. Thus, one can have the sense both of travelling long distances through the 18 episodes and of standing still looking through layers of time.

The analogy causes one idea to merge into another, making the analogy, the heart of the novel's structure, as mystical as alchemical correspondences. Analogies are, therefore, not to be taken as one-to-one correspondences at each and every point; if they are, they become homologies or identities in which everything is "One" and in which "This is verily that". In the end, perhaps the joke or ultimate

irony is precisely this, that the heart of the labyrinth is attainable only by mystical intuition.

Joyce's Ulysses stands at the edge of the second scientific revolution, and reflects many of the concerns of that time of transition.[3] When radioactivity was discovered in 1896, it gave back to biologists the time required for Darwinian evolution to have occurred; Mendel's quantitative genetics made biological mysticism not as necessary as it had been; the discovery of the configuration of the molecule, which relied on the solar system as its model, united heaven and earth in a true macrocosm-microcosm. The literary parallel in Ulysses to these changes is the Penelope episode. The new day, as yet unformed, indicates that although one cosmology was receding into myth, the raw materials were available for the building of a new heaven and new earth.

The Ithaca episode has for too long suffered the neglect of the critics. Yet its lack of literary splendour reveals clearly the centrality of scientific ideas not only in the episode itself but also in the modern "Odyssey" of which it is the culmination. Perhaps through an examination of these ideas Ithaca can begin to take its rightful place at the heart of Ulysses as it has in that of its weary traveller.

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[3] Bernhard Fehr has examined scientific ideas in Ulysses from another perspective: he considers the novel a comic version of Einstein's Special Theory of Relativity of 1905. "James Joyce's 'Ulysses'," Englische Studien, LX (1925), 180-205.

Chapter I

In the Ithaca episode, we learn that Bloom, in his "middle youth", had, with equanimity, spent time observing through "a rondel of bossed glass of a multicoloured pane" the spectacle of people, animals, and vehicles "passing slowly, quickly, evenly, round and round and round the rim of a round precipitous globe."[1] In his middle age, to aid his digestion, he contemplates inventions once new and revolutionary but now "principally intended for an improved scheme of kindergarten—astronomical kaleidoscopes exhibiting the twelve constellations of the zodiac from Aries to Pisces, and miniature mechanical orreries" (799), machines designed to illustrate the motions of the planets and constellations.

Between Bloom's youth and his middle age, a world view has come and gone, a view once certain enough to have been accepted with equanimity, with wholehearted belief, but now reduced to a digestive aid (so that reality will be easier to swallow) and to mechanical kindergarten toys (because only children in their innocence will believe that they represent reality). That this world view is expressed

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[1] James Joyce, Ulysses (London: Bodley Head, 1960), p.796. All subsequent references to Ulysses will be given in parentheses in the text and will be to this edition.

through inventions indicates its dependence upon technology; it also indicates an important connection between the mechanical picture and education.

It is a view which began in ancient astronomy and physics, and culminated in Newtonian science and in the Enlightenment view of that science. Circularity (uniform circular motion) points to its perfection, its unchanging nature, its invincibility. But like most things on this "precipitous globe", the mechanical model of the universe had to be discarded when it no longer adequately explained phenomena, when it no longer seemed credible even to those who opinions (or idées reçues) were based largely upon a very successful technology, the major consequence of this model. It is, by Bloomsday, a paradigm based upon a no longer totally correct conception of the universe, a metaphor returning to myth.

If the Newtonian paradigm is part of Bloom's "enlightened" middle youth, then the views of his early youth, given that he represents the "scientific temperament" (798), are probably those of early science and of the scientific revolution of the 16th and 17th centuries. Insofar as he is representative of modern scientific and technological man, his thought parallels the effects of science on the "ordinary" man. Therefore, it seems a fruitful and necessary exercise to examine some of the scientific thought that has

gone into making Bloom what he is.[2]

One of the more remarkable things about Bloom is his knowledge of the stars.[3] In the Wandering Rocks episode, Lenehan explains to McCoy Bloom's astronomical prowess: "Bloom was pointing out all the stars and the comets in the heavens . . . the great bear and Hercules and the dragon and the whole jingbang lot. But, by God, I was lost, so to speak, in the milky way. He knows them all, faith." (301). In Ithaca, during their "consubstantiation", Bloom points out various constellations to Stephen as a comet passes overhead (826). This is only one instance of the approximately recurrent nature of events in Ulysses, of its cyclical quality. Bloom's interest in astronomy links him to the oldest of the sciences.

Because planetary motions are almost cyclical, it was probably in the heavens that men first perceived the

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[2]This chapter is not intended as a history of science from ancient Greece to 1904. What it does purport to be is an examination of only some of the scientific ideas that Joyce chose to include, for literary purposes, in Ulysses. As a result, there are gaps and superficialities which are excusable only insofar as they may reflect the larger pattern of "Joyce's choices".

[3]It is clear that Bloom recognizes the stars and constellations; what is less clear is his knowledge of the science of astronomy. With principles he has, here and elsewhere, difficulty. He has factual information but no real systematic knowledge.

orderliness of the universe, and entered on the pathway to science.[4] Even before the Greeks, the lengths of the month and year had been measured, the causes of eclipses of the sun and moon had been determined, and cycles for explaining the apparent motions of the planets had been developed.[5] The ancients knew seven heavenly bodies that appeared to move among the fixed stars; the fixed stars, because the constellations retain their shapes, they thought were tacked onto the inside of a rotating sphere with the earth at the center. They believed that the stars moved in perfect circular paths and were, therefore, immutable, while the planets, with their apparently irregular motions, seemed to be intermediaries between the perfection of the stars and the imperfection of the sublunary sphere. Therefore, the task of the early astronomers was to find the combinations of perfect circular paths along which they thought the planets actually did move. The efforts of astronomers were, thus, for centuries, devoted at least partly to solving this problem. The result was that later Greek astronomers were obliged to fit the observed motions with very complicated superpositions of circular motion as, for example, in Ptolemy's

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[4]F. R. Moulton, "Influence of Astronomy on Science," Scientific Monthly, 67 (1938), 301.

[5]Moulton, p.301.

system of epicycles.[6]

To the Greeks is also attributed the greatest advance in logical mathematical investigation from prehistory to the Renaissance. The study of geometry, begun with the founding of the Ionian School by Thales of Miletus in the 6th century B.C., was greatly furthered by the Pythagoreans, and reached its peak of development with the First Alexandrian School (4th to 2nd century B.C.) which included Euclid and Archimedes.[7] In their search for a principle of unity in nature, the Pythagoreans asserted that the world is made of number and that numbers have shape. To them, the world was actually made of lines, triangles, squares, cubes, and circles; that is, they regarded numbers spatially. One is the point, two is the line, three is the surface, four is the solid; this meant that all bodies consist of points or units in space which taken together constitute a number. Numbers contained the form of things, at once real and ideal. In them lay the clear eternal structures among the chaos of

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[6]Physical Science Study Committee, Physics (Boston: D. C. Heath and Company, 1960), pp.344-46. The epicycles were complex because they were calculated from the point of view of the earth. This is what Copernicus changed with his heliocentric theory. His major reason for subscribing to this view was that it enabled him to get rid of many of these cycles.

[7]Moses Richardson, "Mathematics," The American Peoples Encyclopedia, 1956. Ptolemy belonged to the Second Alexandrian School (A.D. 100-300).

phenomena.[8]

From the Pythagorean tradition originated the mysticism of number, the numerology which plays so important a role in Ulysses. For example, the squaring of the circle is a problem of sacred geometry in the Circe episode where its solution would entail a rational solution of a mystical problem: combining the two figures would unite heaven's perfection (the circle, the number three, the trinity) with the corrupt material world (the square, the number four, Satan). The ancient Greeks had solved the problem of constructing by straight-edge and compasses a square equal in area to a given triangle, rectangle, and certain other polygons, but the problem of squaring the circle resisted solution. Bloom, in the Ithaca episode, also mentions that the "secular", that is, algebraic rather than geometrical, solution to this problem is a way to win a million pounds (845). That the solution is an irrational one is shown in Bloom's third meditation (820).[9] Modern mathematicians have proven by algebraic theory that this construction is impossible by Euclidean methods.[10]

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[8]Frederick Copleston, A History of Philosophy, vol. 1, part I (New York: Image Books, 1962), p.50.

[9]See Chapter III, pp.132-3.

[10]Richardson.

The Pythagoreans also discovered the mathematical side of music by studying stringed instruments. They found the relationship between the length of a vibrating string and the pitch it emits, and they expressed harmony as a geometrical quantity. The instrument they used to calculate and to sound the ratios was the monochord, a soundbox over which was stretched a single string divisible at any point by a movable bridge.[11] In Sirens, Bloom sounds out Pythagorean ratios "troubled double, fourfold, in octave" on an elastic band (353) while reminiscing of "Love's Old Sweet Song". In the Middle Ages, these ratios were incorporated into the university curriculum through the influence of Augustine's De Musica in which he divided music into three levels corresponding to a particular realm of the universe.

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[11]Dividing a string at the half raised the pitch an octave; at two-thirds a perfect fifth; at three-quarters a perfect fourth. These are the most prominent notes of the musical system. The fourth and fifth being found, the interval between them (the tone) was accepted as standard. The interval between the first note and the fourth, and between the fifth note and the last, was divided by marking out two tones, with half a tone remaining in each case. Thus, the logical series was two tetrachords each of two whole tones and one semitone. The series could be arranged in three possible ways: semitone, tone, tone (Dorian tetrachord); tone, semitone, tone (Phrygian tetrachord); tone, tone, semitone (Lydian tetrachord). The names of these arrangements do not correspond to the later mediaeval modal names because the Church in the 16th century applied incorrect names to them, and they stayed in use. The monochord was more a scientific instrument than a musical one: Percy Scholes, ed., The Oxford Companion to Music, 10th ed. John Owen Ward (London: Oxford University Press, 1970), pp.915, 655-6.

Musica instrumentalis, at the lowest level, included both vocal and instrumental music; its purpose was the concrete demonstration of the fundamental Pythagorean ratios. This is the musit which Bloom listens to and plays in Sirens. Musica humana, both physical and spiritual, related the external symmetry of the body and the beauty of the internal organs to their functioning and well-being. Bloom's concerns with diet and exercise fit this description. Musica mundana was the music of the spheres, the harmony at the foundation of the world, earth, stars, and heavens, although this music could not be heard.[12] The result of Bloom's interest in both astronomy and music (his wife is a singer) is indicative of the confusion of modern sphere music: his world is slightly askew because Molly may be having an affair. He knows the facts in the one instance (astronomy and music) but has no real understanding of the whole picture; in the other, he understands the situation, but he doesn't know the facts. "Love's Old Sweet Song" may put his defences down, lull him into depression, but not for long. Music, he concludes, "gets on your nerves". In the Ithaca episode, the music of the spheres is what Stephen hears as "Liliata rutilantium. Turma circumdet. Iubilantium te virginum.

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[12] Albert Seay, Music in the Mediaeval World (Englewood, New Jersey: Prentice-Hall, 1965), pp.7-24. The astronomer, Kepler, later thought he had found these basic ratios in the motions of the planets.

Chorus excipiat"[13] and what Bloom hears as "Heigho, heigho, heigho, heigho" (826-7). The true identity of modern sphere music is thus questionable. The music corresponding to the musica instrumentalis of the Sirens episode is, in Ithaca, the Harry Hughes legend.

The ideas of the Pythagoreans centered around purity and purification, the doctrine of transmigration of souls naturally leading to soul cultivation. The practice of silence, the influence of music, and the study of mathematics were valuable aids in tending the soul. If the Pythagoreans prohibited the eating of meat, it may have been due to the doctrine of metempsychosis.[14] Bloom's mathematics is restricted to calculating the number of barrels of porter that will make someone a million pounds: "Twopence a pint, fourpence a quart, eightpence a gallon, no, one and fourpence a gallon of porter. One and four into twenty: fifteen about. Yes, exactly. Fifteen million barrels of porter. What am I saying? Gallons. About a million

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[13]This prayer, said by the bedside of the dying during the death agony, is translated as "may the lilied throng of radiant Confessors encompass thee; may the choir of rejoicing Virgins welcome thee." Weldon Thornton, Allusions in Ulysses (1961; rpt. New York: Simon and Schuster, 1973), pp. 17-18. This prayer is first heard in Telemachus; its repetition here indicates that very little has changed for Stephen during the day.

[14]Copleston, 1, I, p.47. Father Copleston sees the Pythagoreans as representative of a religious revival at the close of the Ionian civilization much as the end of Roman civilization was marked by the rise of mystery cults, (pp.45-47).

barrels all the same." (Lotus Eaters, 97). Bloom is able to keep better track of his smaller budget for June 16th in Ithaca (836), although there, too, he dreams of receiving cash payments which would increase "constantly in the geometrical progression of 2 (1/4d., 1/2d., 1d., 2d., 4d., 8d., 1S.4d., 2S.8d. to 32 terms)." (845).

As for his soul, Bloom tends to that by taking care of his body. He watches his diet, and ascribes the insubstantiality of the aesthetes to their unsubstantial vegetarian diet. Metempsychosis, as he has tried to explain to Molly who calls it "met-him-pike-hoses", is transmigration of the soul, "many happy returns", but he is not convinced of this possibility himself because it does not account for the body.[15] In Hades, he imagines "that last day idea": "The resurrection and the life. Once you are dead you are dead. . . . Knocking them all up out of their graves. . . . Get up! Last day! Then every fellow mousing around for his liver and his lights and the rest of his traps. Find damn

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[15]The word keeps recurring to him throughout the day until in Ithaca he imagines himself wandering "self-compelled, to the extreme limit of his cometary orbit . . . to the extreme boundary of space . . . whence . . . he would somehow reappear reborn . . . and . . . return an estranged avenger . . . ". But he realizes that this idea is irrational because there is an "unsatisfactory equation between an exodus and return in time through reversible space and an exodus and return in space through irreversible time." (858). That is, his hope to avenge Molly's real or imaginary infidelities and the offenses that as a Jew he has experienced during the day is fairly hopeless because he cannot change the past, his or anyone else's.

all of himself that morning." (133). This is the ultimate expression of the law of conservation: while no souls or bodies are utterly destroyed, nothing new is created either; in Bloom's version of conservation, identity must be maintained, that is, each person must find his own liver. (Stephen's version of this problem is the transubstantiation in the Mass.) Thus, considerations of the unity of the soul and body in eternal life as expressed in the mathematically irrational attempt to square the circle, along with the doctrine of metempsychosis, are an extension of Pythagorean science, a combination of mathematics and mysticism, to modern life.

Plato and Aristotle, each for different reasons, held that the union of geometry and physical objects was impossible because they agreed that mathematics and physics do not fit.[16] For Plato, mathematical relationships were eternal, ideal, and therefore real, the world of things and physics corrupt. In Scylla and Charybdis, Stephen, as Aristotelian, argues with Eglinton and Russell against poets and thinkers of the Platonist persuasion who would have art "reveal to us ideas, formless spiritual essences" (236) rather than have art and thought reveal in language their essence through form. He is countering what he sees as an attempt by the mystical

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[16]Charles Coulston Gillispie, The Edge of Objectivity: A Essay in the History of Scientific Ideas (Princeton: Princeton University Press, 1960), p.15.

poets of the "opal hush" to make language approximate the condition of music; that is, he considers music (time) mystical and would maintain the spatial quality of language. When Bloom happens across George Russell (A.E.) and Lizzie Twigg, he remarks that "Those literary people they are all. Dreamy, cloudy, symbolistic. Esthetes they are. I wouldn't be surprised if it was that kind of food you see produces the like waves of the brain poetical. For example one of those policemen sweating Irish stew into their shirts; you couldn't squeeze a line of poetry out of him." (Lestrygonians, 210). To Bloom these people are cloudy because they lack substance, that is, food; the same people to Stephen are cloudy because they lack form.

Aristotle considered that physics deals with the real, and that mathematics is only true in the abstract, the world itself being made up of qualities and forms which cannot be expressed in the precise, quantitative, and unreal terms of mathematics. Thus, when he translated Plato's metaphysics into physics, he made a distinction between cosmology and physics, the one concerned with the heavenly regions, the other with the mortal and contingent. This dichotomized the Greek cosmos until Newton's law of gravity united them in a single science of heaven and earth.[17] This separation of the heavenly regions from the earth also

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[17]Gillispie, pp.14-17.

cut the gods off from reality; this is the reason that Bloom, when thinking about "shapely goddesses, Venus, Juno . . . immortal lovely", distinguishes between them and humans on the basis of their not having bodily functions: "And we stuffing food in one hole and out behind: food, chyle, blood, dung, earth, food: have to feed it like stoking an engine. They have no." (224-5). Bloom relegates them to the sphere of unreality, to Plato's ideal world; the cycle of this world, the world where people, like machines, have to be fed, only to become food themselves, is what is real to Bloom because it is physically real. Therefore, his correspondence with Martha Clifford through his identity as Henry Flower, that is, his own potential infidelity, is not likely to occur because it belongs to that "other world" which does not hold Bloom's interest for long. In Circe, because he recognizes the unreality of inhuman ideals such as the statue of the nymph, he is able to free himself of their spell.

Aristotle systematized the first science of this world, mechanics. According to his anthropocentric physics, earthly matter in motion sought the center of the earth since this is its natural goal. The more massive an object, the more rapidly it fell because the goal varied according to the composition of matter (earth, air, fire, water); thus, the heavier the object, the greater its tendency to seek the center of the earth, and the faster it would fall. Apart from the four elements was a fifth, the quintessence, of which the

heavenly bodies were supposed to be composed. Only one motion, the circular, was perfect, and remained so until Kepler, for only in circles could motion occur as changelessness.[18] Thus, circularity was the connection between this world and the world of the heavenly regions, the mortal and immortal.

However, despite the incorrectness of this physics and astronomy, due largely to a lack of experimentation, the Greeks, Aristotle in particular, took a great scientific step forward when they discovered that language can be idealized and rendered precise enough for logical deduction. Aristotle's common sense physics started from experience, and moved through definition, classification, and deduction to logical demonstration.[19] Its instrument was the syllogism, not an equation; it was verbal, not mathematical. Its primary goal was to achieve a rational explanation of the world by showing how phenomena are adapted to a larger order, and it therefore fell in with a sense of providence in nature.

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[18] Gillispie, p.11.

[19] Gillispie, p.12. Werner Heisenberg, Physics and Philosophy (1958; rpt. New York: Harper Torchbooks, 1962), p.169. Heisenberg writes, ". . . Aristotle in his logic started to analyze the forms of language, the formal structure of conclusions and deductions independent of their content. In this way he reached a degree of abstraction and precision that had been unknown up to that time in Greek philsophy and thereby contributed immensely to the clarification, to the establishment of order in our methods of thought. He actually created the basis for the scientific language."

Thus, Aristotelian science was at once anthropocentric, teleological, and linguistic. The development of modern science was, in large measure, a carving away of these characteristics. The "larger order" with which Aristotle starts and to which phenomena are adapted was later reversed: his deductive science gave over to an inductive one in which phenomena determine what, if anything, can be said of the larger order, or model, of the universe.

But Greek science wasn't all purely intellectual. Archimedes (287-212 B.C.), for example, was not only a mathematician but also the inventor of the science of hydrostatics, the study of the behaviour of liquids at rest.[20] As legend has it, he had to determine for his king whether a crown was actually gold or another metal. He noticed that when he immersed himself in his bath, the water level rose, his body having displaced some of the water. Archimedes' principle, supposedly inspired by this episode, states that a body immersed in a fluid loses weight equal to the weight of the fluid displaced. If the body floats, the weight of the fluid displaced must be equal to the weight of the body. Thus, because each solid substance has a specific weight or density, its identity can be recognized with certainty in

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[20] M. E. C., "Archimedes," The American Peoples Encyclopedia, 1956. Archimedes is also reputed to have used mirrors to confound the enemy in the Second Punic War, and to have constructed an orrery, a sphere on which the movements of the heavenly bodies are represented. This is the instrument Bloom thinks of using in his kindergarten scheme.

this manner.[21] With Bloom, Archimedes' principle is expressed thus: "Where was that chap I saw in that picture somewhere? Ah, in the dead sea, floating on his back, reading a book with a parasol open. Couldn't sink if you tried: so thick with salt. Because the weight of the water, no, the weight of the body in the water is equal to the weight of the. Or is it the volume is equal of the weight? It's a law something like that." (Lotus Eaters, 87). This isn't the only instance of Bloom's having difficulty remembering abstract principles. It is obviously easier for him to remember a concrete particular than an imageless abstraction, a principle applied rather than pure. The chap with the parasol doesn't "sink like a stone" because his density is light in comparison to his volume whereas a stone is very dense in comparison to its volume—even in salty water. Bloom forgets that increasing volume increases buoyancy so that a steel boat hull floats despite its enormous weight because its hollow volume is large enough to give it buoyancy. Thus, Bloom realizes that there is a world of scientific explanation, of principles he could appeal to were it not for the fact that because they are abstract and require precision, they usually lie somewhere too far "above his head" to be of much use to him. Nevertheless, he continues to cite them, or some version of them, because they give him

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[21] D. A. Keys, et al., An Elementary College Course in Experimental Physics (1949; rpt. Montreal: Renouf Publishing Company, 1961), p.24.

the comforting idea that they actually are "up there".

Until Kepler (1571-1630), circularity remained the basis of cosmic order, things ever rounding back on themselves. Even Copernicus, in 1543, had based his heliocentric theory of the universe on the perfection of the circle. What was significant about Copernicus's theory was his discovery that if he changed the frame of reference of the planetary motions so that the sun was at rest and the planets moved around it, he could simplify the description of their movements and rid himself of some of the complexities of the Ptolemaic system. Thus, Copernicus's theory encouraged a conceptual rather than an actual change.[22] However, his theory undermined both Greek cosmology and Aristotelian physics.

> In a Copernican universe no physics could survive which depended on a central earth as the locus of the heavy. . . . But for cosmology too, the implications went beyond the choice of geometrical systems. Where does the world begin or end, if the earth is not the center? How deep are the stars set into space, if they are not pinpricks on the dome of the cosmos?[23]

If the extent of the universe could not be determined with any accuracy, then the imagination by itself would soon enough make it infinite.[24] Thus, Copernicus's theory touched

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[22]Gillispie, p.25.

[23]Gillispie, p.27.

[24]Gillispie, p.27.

man's position as the center of the universe; in this, it was a decisive step away from anthropocentrism, from man's belief that the universe was made for him.

What Kepler did was to discover that the orbits of the planets were ellipses, not circles, through painstaking calculations.[25] Using the data of Tycho Brahe, Kepler showed that the orbit of Mars could be fitted accurately by an ellipse with the sun at one focus and that a line from the sun to a planet sweeps out equal areas in equal times. These were essentially empirical observations and the eight minute coincidence in which Kepler threw out six years of work because his calculations did not agree with Brahe's observations indicates a fundamental move away from the primarily intellectual science of the Greeks.[26] However, Kepler was motivated by a mystical desire to see unity in the universe; he therefore tried to reconcile the physical world of his ellipses with the Pythagorean world of geometrical and musical harmony.

In De Harmonice Mundi, published in 1619, Kepler considered the ideal geometric proportions according to

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[25]Kepler had to calculate because he had no telescope; Galileo invented his telescope in 1609, the same year that Kepler published his first two planetary laws in Astronomia Nova. The third law was published in De Harmonice Mundi in 1619. Newton later used these laws in formulating his theory of universal gravitation.

[26]Gillispie, pp.33-37.

which God had created all existence. As the Pythagoreans had discovered, the invariable ratios between the lengths of instrumental strings give the octave, fifth, and fourth which we perceive as musical harmonies; Kepler wished to endow this music with universal meaning. In this search, he found not only his third law (that the velocity of a planet varies inversely with its distance from the sun) but also that profounder meaning. By determining the least and greatest values of the angular velocities of each of the planets from the sun, he saw that for Saturn the ratio is 4:5, the major third; for Jupiter, it is the minor third; for Mars, it is the fifth. Thus, in the music of the spheres, Saturn and Jupiter take the bass, Mars the tenor, Earth and Venus the alto, and Mercury the soprano—such were Kepler's flights of musical astronomy.[27]

This desire to find a meaning in things beyond the mere fact of their existence is a search for the ultimate expression of all phenomena, in other words, God as he mani-

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[27]Gillispie, p.38. In the Sirens episode, supposedly a fuga per canonem, the four voices are present. That they are connected to Pythagorean ideas is indicated by Bloom's sounding out the ratios on his elastic band. He further connects these voices to physics by transposing (inaccurately) Galileo's law of falling bodies into a "law" of acoustics, "chamber music". His inaccuracy reflects not only the impossibility of hearing sphere music except through a mystical experience or hallucination but also the important connection between music and the ultimate laws of the universe; these laws which in the Mediaeval quadrivium clearly pointed to the existence of God are, in the modern world, no longer meaningful, not even comprehensible.

fests himself in nature. Kepler's science thus retained a mystical element by which coincidences are more than mere accidents; they are signs of God and the future. In Ulysses, Bloom mentions seeing A.E. twice in one day and attributes to this and to coincidences in general a meaning beyond chance or the fact that in a city the size of Dublin it was quite possible for this to occur through proximity or for any number of reasons. It also seems reasonable to suppose that at a time when uncertainty about all meaning is at its greatest, the desire for it would also be correspondingly high so that anything could be construed as a sign or symbol through which God and the future will reveal themselves.

The connection between Kepler's ellipses and music also points to a problem of identity. In the Circe episode, Stephen connects the astronomical ellipse ("nodes") to music ("modes")[28] through the circle of fifths. In music, the various modes are related to each other through their dominants (fifths). The dominant of one mode can act

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[28]The modes were not keys in the sense that we understand them today. All our major (and minor) keys are, except for pitch, precisely alike. The difference between one and another is not the kind of difference that exists between, for example, D major and A major, but of the kind that exists between A major and A minor: the difference is in the arrangement of tones and semitones, and thus necessarily of the width of the other intervals. The reduction from the eight Ambrosian modes (the twelve Gregorian modes were not adopted for use in the plainsong of the Church) to the two modern modes (major and minor) resulted in a serious loss of "flavour" because each mode had had its own particular character. Denis Stevens and Alec Robertson, eds., The Pelican History of Music, vol.1 (London: Penguin Books, 1960), pp.153-160.

as the fundamental of another mode whose dominant, in turn, can become the fundamental of still another mode, and so on. By this procedure, one can progress through all the modes to arrive back to the original starting point.[29] Stephen characterizes this relationship as "the greatest possible ellipse. Consistent with. The ultimate return. The octave." (622). Because the natural resolution of a dominant (the farthest point) is to its fundamental or octave, and because the octave is the same note as the fundamental at a higher or lower range, the appearance of progression from fundamental to dominant becomes in reality a return to the fundamental; in

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[29]Clearness of identity was possible in the old modal system because, even though not fixed to any particular starting point, each mode was characterized by its own arrangement of intervals and thus retained its own character or identity. Where the circle of fifths becomes really important is in the modern tonal system in which all the varieties of each of the two remaining modes have the same interval arrangement. If one progresses upwards by fifths from G, the resulting keys are D, A, E, B, F sharp; downwards by fifths from F, the keys are B flat, E flat, A flat, D flat, G flat, C flat. In this "circle", the last three keys in each series are close, but not identical, in pitch; they are almost a circle. They can be made identical through equal temperament, according to which the octave is divided into twelve equal semitones so that the key of B is identical to the key of C flat, F sharp is identical to G flat, and C sharp is identical to D flat. (Roger Sessions, Harmonic Practice (New York: Harcourt, Brace and World, 1951), pp.8-9). The importance of this circle and of equal temperament is the possibility they give for enharmonic modulation simply by a change in notation, theoretically making it possible to encompass in a single piece of music all possible tonality. Thus, the key of F sharp mentioned in Sirens might equally well be G flat; the actual key could only be determined by seeing the written music. Real identity is thus problematical in music as elsewhere.

this sense, a going forth to the ends of the earth, or the heavens, results in a meeting with, or a becoming of, oneself. By this logic, a mystical union with God is a union with one's own projection.

Stephen expresses the idea of identity as a riddle: "What went forth to the ends of the world to traverse not itself. God, the sun, Shakespeare, a commercial traveller, having itself traversed in reality itself, becomes that self. . . . Self which it itself was ineluctably preconditioned to become." (672). Such an idea, in which form determines phenomena, indicates a necessity to include a telos or final cause in the explanation of development; in this, Stephen has not rid himself of the "priest" in his thinking. His need to believe in the possibility of attaining a predetermined form, the Aristotelian notions of potentia and entelechy, is a need of mysticism, of a complete identification of self and external world.

While neither Copernicus nor Kepler broke entirely with the mystical Christian tradition in their science, Galileo stripped from the cosmos all Platonic/Pythagorean mysticism, leaving only mathematical dimension.[30] The thought of

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[30]Gillispie, p.40. The general spirit of secularization in the Renaissance, and the growing influence of the new science, provoked a desire to introduce uniform standard musical notation as well. Exactitude of pitch was effected by the staff which began as a single line and then had companion lines added to it. These defined pitch and became standardized for plainsong, the traditional ritual melody of

the earth's motion and its mathematical treatment in astronomy led him to see that small parts of the earth's crust were also amenable to mathematical quantification. In so doing, he swept away concern with scholastic substances and causes. The ultimate why of motion, which Aristotle had accounted for teleologically, gave way to the notion that bodies are equipped with none but mathematical qualities, and that they move in homogeneous space and time. Through the primary properties—length, width, height—the actual process of motion could be formulated mathematically rather than merely described geometrically. The secondary qualities—color, taste, odor, texture—he considered modes of perception rather than real essences permeating matter. He thus distinguished between object and subject.[31]

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the western Christian church, as a staff of four lines. The clef first appeared in the neumatic system, signs for notes or groups of notes developed for recording plainsong melodies. The clef fixed the pitch of one of the lines of the staff and, consequently, of all the lines and spaces. The Gloria following Stephen's parody of the Credo in Scylla and Charybdis (253) is written in the modal neumatic notation. This notation was rather vague, giving only the general curves and rhythms of the melody, and in the relationship between music and words, words were the more important of the two. That the Harry Hughes legend in Ithaca is written in modern notation indicates that science had influenced through notation the relationship between music and words.

[31]Edwin Arthur Burtt, The Metaphysical Foundations of Modern Science, rev. ed. (London: Routledge and Kegan Paul, 1932), pp.197-201.

This division was to have profound effects: in combination with the development of perspective in art, it continued the process of dethroning man from his position as the center of the universe begun with Copernicus, and made him an observer somehow justifiably apart from nature. As observers, both scientists and artists moved outside their work. The separation was justifiable insofar as human secondary qualities interfered with the truth about a nature whose significance lay in its primary, that is, measurable qualities, and insofar as irrational prejudices, enthusiasms, and expectations clouded the certain, verifiable, and generalized knowledge attainable through objectivity. That this objectivity came eventually to be thought a fallacy is demonstrated by the omniscient, impersonal narrator (odorless, colorless, tasteless) parodied in the Ithaca episode.[32] In science, this notion of objectivity, of the neutral observer, culminated in the realization in the early 20th century that the experimenter alters what he observes merely by the act of observing it. In the meantime, however, science (and, later, technology), through its method, began to take on an existence independent of any single human being.

Galileo's contribution to physics was his law of falling bodies, his idea that in the absence of air resist-

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[32]For a discussion of this narrator-persona in the Ithaca episode, see Chapter III, pp.108-111.

ance all objects would fall to the earth at the same acceleration independent of their mass. The dropping of an object results in its falling straight down; throwing it horizontally results in a curved trajectory: this motion Galileo analyzed into two independently functioning components, a force that causes the object to drop vertically, and an "inertial" component that would maintain the object infinitely on a horizontal straight line. Whereas in Aristotelian physics maintaining an object in motion required the continuing action of a force, in Galilean physics this is turned around: in the absence of friction, the object would keep on moving until a force either stopped it or altered its motion. Galileo saw that both a state of rest and a state of uniform motion in straight line are situations in which no forces act. Forces change the state of motion, producing acceleration or deceleration.[33]

Bloom expresses this law of falling bodies, or free fall, in the following manner: "What is the weight really when you say the weight? Thirty-two feet per second, per second. Law of falling bodies: per second, per second. They all fall to the ground. The earth. It's the force of gravity of the earth is the weight." (Lotus Eaters, 87). The "weight" he tries to explain to himself is actually the "mass" mentioned above, a measure of the force of gravity upon all

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[33]Jeremy Bernstein, Einstein (London: Fontana/Collins, 1973), pp.29-31.

objects on the earth; it is the reason "they all fall to the ground". What seems to interest him more than the content of the law, however, is the sound of the repetitions. Later, when he hurls at the gulls the crumpled throwaway announcing the arrival of the Messiah, he remembers the law as "Elijah thirty-two feet per sec is com" (Lestrygonians, 192), but forgets the crucial repetition. This is consistent with his memory and understanding of the principles of physics, but when "Ben Bloom Elijah, amid clouds of angels ascend(s) to the glory of the brightness at an angle of fortyfive degrees over Donohoe's in Little Green Street like a shot off a shovel" (Cyclops, 441), he is engaged in an applied version of Galilean acceleration, "force" having changed his uniform motion. Bloom's notion of generalization includes an application of another version (his) to musical acoustics: "Chamber music . . . Acoustics . . . Because the acoustics, the resonance changes according as the weight of the water is equal to the law of falling water" (Sirens, 364), but the most important generalization, which he perhaps hasn't considered, is his free fall from Howth Hill, his descent from the high estate of those happier days with Molly.

What was revolutionary in Galileo's law of falling bodies was his treatment of time as an abstract parameter of any physical event which enabled him to quantify motion

in number.[34] But as nature became objectified through measurement, so much less was it to be grasped by intuition; it lost any sympathy and humane association. As science came to communicate increasingly in the language of mathematics, the measure of quantity, in which no terms exist for value, the language of will and purpose and hope in connection with nature had to be abandoned; force changed from personal power into mass times velocity. Thus, despite his reliance on science and technology to order his world, Bloom derives no consolation, or order, from principles he cannot understand. Galileo's mathematicization of nature, the crucial act in the scientific revolution, effected the subsequent separation of the sciences and humanities so that only an expert, which Bloom is not, could by the 20th century keep up with scientific developments. It is thus ironic, and sad, that the view upon which Bloom bases his attempts to understand the world is almost completely inaccessible to him,[35] that his only access to its certainties is through

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[34] Gillispie, p.42. "During the scientific revolution, ideas about time in general were beginning to change. The invention of the mechanical clock dissociated time from human events and played a central role in the idea of a mechanical universe. Old cyclical ideas of time had depended on a discontinuous repetition of temporal units, whereas the mechanical clock tended to make time homogeneous, continuous, and linear. G. J. Whitrow, The Nature of Time (London: Penguin Books, 1975), pp.21-22.

[35] This is doubly ironic in that the later successes of the scientific method forced the humanities to derive certain knowledge from the sciences. Bloom is thus doubly cut off.

technology. Paradoxically, science is thus at once the source of his comfort and the cause of his confusion.

However, although Galileo considered motion natural and made it persist, he made natural motion circular. No longer the center of the cosmos, the earth still remained the center of motion. It was Descartes who changed natural motion from the cyclical to the straight line infinite. In its absolute abstractness, Descartes' idea completely ignored physical evidence. "He was able to identify as the foundation of physics that which can never occur in fact—rectilinear motion, motion persisting in a straight course to the place where parallel lines meet in the nevernever land at the end of an infinite universe."[36] Thus, Bloom's imagining his father-in-law, Major Tweedy, "retreating, at the terminus of the Great Northern Railway, Amiens street, with constant uniform acceleration, along parallel lines meeting at infinity, if produced: along parallel lines reproduced from infinity, with constant uniform retardation, at the terminus of the Great Northern Railway, Amiens street, returning" (Ithaca, 861) is a comic debunking of this notion by a literal mind. Where, after all, does infinity begin or end? Is it a place from which one can come or go? And if it takes an infinite amount of time to go through an infinite amount of space, then how is it possible to ever return? What Bloom

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[36]Gillispie, p.90.

doesn't understand is that while infinity in space and time is an abstract concept necessary to mathematical science, it is a concept without physical meaning.

For the same reason, the problem represented by the squaring of the circle, that is, the attempt to unite heaven and earth, is doomed to physical failure. In Circe, where it is used as the geometrical basis for the attempt to construct the sacred city, the New Jerusalem, the irrationality of the radius of the circle precludes this physical application. The only recourse is to a mystical, or hallucinatory, construction, itself irrational; also, because it has no physical reality, it cannot have any reality for Bloom. This also suggests that Bloom's quest to gain for himself a world view incorporating both the physical world and the spiritual through science is doomed to failure as well. In this interpretation, any affirmative reading of the novel's ending is clearly unjustified because it is not enough for Bloom and Molly merely to occupy the same bed; they must be seen to produce a living offspring which they obviously do not do. (Milly is the product of the time when they could.)

The development of a theoretically infinite universe was probably even more disorienting than man's loss of his position as the center of the universe had been. The problem was not only the infinite size of the universe but also the impossibility of ever again feeling that he has a place in it or, more accurately, the impossibility of ever knowing

what that place is. "For there can be no mean between the finite and the infinite, no correspondence by science or any route between man and the universe, no place in nature where man specifically belongs because there is no such thing as place in infinity."[37] Thus, Bloom, seeing, or imagining he sees, the imprint of a male form next to Molly as he is about to climb into bed, reflects on the notion that "each one who enters imagines himself to be the first to enter whereas he is always the last term of a preceding series even if the first term of a succeeding one, each imagining himself to be first, last, only and alone, whereas he is neither first nor last nor only nor alone in a series originating in and repeated to infinity." (Ithaca, 863). This means that Bloom is forever inevitably and ineluctably a cuckold.

Not only did Descartes postulate a mathematically infinite universe, but, convinced that mathematics was the key to unlocking the secrets of nature, he also attempted to reduce all of nature to a geometrical system.[38] The non-

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[37]Alexandre Koyré, quoted in Gillispie, p.84.

[38]Cartesian geometry is algebra applied to spatial relationships; with it, scientists can write an equation for a line or circle, not merely draw it. Newton based his calculus on analytical geometry.

One of the results of the Cartesian method of accepting only "clear and distinct" ideas, and of the heavy reliance on mathematics was the effect these had on language and on concepts expressed through language (Heisenberg, p. 172). It came to be thought that words and concepts could

geometrical, or secondary, qualities he banished out of the realm of space and made into modes of thought. Because mind, unlike matter, is not extended in space, it became a substance totally different from extension and existing independently of it. He also proposed a universal mechanism to keep the planets in orbit and to hold the world together; extended to biology, the hydraulics of the circulatory system became a vision of animals and humans as machines. In this way, Descartes constructed the first mechanical cosmology, substituting the impersonality of the machine for the purposiveness of the organism.[39] Bloom's notion of eating as "stoking an engine" is a biological analogy based upon mechanical principles, and his idea of the cosmos as a machine thus derives as much from Descartes as it does from Newton, although the laws for the operation of the machine are Newton's.

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only be sharply defined insofar as they were part of a system of axioms and definitions, like mathematics. The effect of this was a detaching of words from concreteness, and a careful control of the connotative power of words. However, such a rational linguistic framework, like its mathematical counterpart, is largely a system of tautologies in which nothing can be said that is not already implicitly contained in the system or grammar. In the Ithaca episode, Joyce makes fun of the attempts to limit connotation.

[39]Because it seemed impossible to ascribe souls to animals, they were relegated exclusively into the res extensa (Burtt, 199). Bloom, however, has no difficulty ascribing souls or thoughts or purpose to animals, especially to his cat. He also animalizes humans. He tries to maintain his res cogitans and res extensa in "parallel synchronicity" through mental and physical exercise, and through diet.

In the 17th century, the system of the ancient Greek atomists was retrieved by those who wanted to do practical as well as theoretical science.[40] Just as Galileo and the theoretical physicists had founded dynamics by their attack on the Aristotelian concept that motion argues a mover or force, so experimental physicists proposed to disprove the impossibility of the void, to set at naught the Aristotelian principle that nature abhors a vacuum. Although it was impossible to demonstrate the existence of the infinite void, they could at least demonstrate the local vacuum.[41] Thus, while Galileo turned motion from process to state, into something amenable to quantification, experimental scientists learned to consider change as a rearrangement of pieces of the objective world.

Enthusiasm for experiment, led in England by investi-

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[40] By distinguishing between mathematical and physical subdivision, the Greek atomists had saved motion from the logical trap of Zeno's paradox in which it is impossible for the hare to ever catch the tortoise because to halve the distance always takes a finite amount of time. (Sir James Jeans, Physics and Philosophy (1958; rpt. Ann Arbor: University of Michegan Press, 1966), p.94). Thus, atomists contemplated a world of number, not abstract number like Plato's, but a world of numerable things.

[41] Toricelli and Pascal both confirmed the existence of a local vacuum. Toricelli, Galileo's student, invented the mercury barometer. The space formed when a column of mercury is inverted into a sustaining tank and falls to its normal height of 30 inches is the vacuum. In 1648, Pascal demonstrated that air pressure declines with altitude.

gators such as Gilbert and Harvey,[42] expanded throughout the 17th century. The English scientists proceeded through the method of specific hypothesis and experiment rather than by geometrical reduction. But experimental science came into its own with Robert Boyle. He confirmed Toricelli and Pascal on the existence of the vacuum by application of an exhaust pump to receivers. He was also interested in rescuing chemistry, the science of combining matter, from the mists of alchemy.[43]

What interested him in his very first pneumatic experiments was less the vacuum produced than the action of the pump itself, and the reaction, or "spring", of the air, which is felt, for instance, in pumping up a bicycle tire by hand. The molecules (corpuscles) of gas, which must be in motion, are the basic units; between them is nothing, the void alone. They occasionally collide and rebound and, because they are spaced wide apart, they can interpenetrate. Thus, widely spaced molecules, moving every which way in

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[42]William Harvey, having used observation and experiment, published his theory on the circulation of the blood (On the Motion of the Heart) in 1628. William Gilbert, who published the first important books on physics in England, set forth the theory that the earth is a gigantic magnet in 1600. He also discovered frictional electricity. Both, along with Copernicus, were at one time or another rejected by Bacon. Gillispie, p.74.

[43]Gillispie, pp.103-07.

empty space, colliding and rebounding as they move—this is the model for gases.[44]

Boyle's law (that at a given temperature the pressure exerted by a gas is proportional to the number of molecules divided by the volume they occupy) helped to define temperature (caloric). The higher the temperature, the higher the molecular speed; increasing molecular motion increases the temperature. Furthermore, this phenomenon is not restricted to gases: material is transmitted from hotter to cooler atoms in general, and the temperature of the substances is equalized.[45] In the bicycle pump, after compression, the motions of the molecules in the hot gas slow down while the other molecules speed up. After a while, the temperature of the pump and that of its surroundings equalize near the original temperature of the larger collection of molecules. This "heat flow" later became important in considerations of the conversion of mechanical energy into heat (and vice versa), the science of thermodynamics upon which the concept of entropy was based.[46]

This model of gases, and the bicycle pump, are cent-

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[44]Physical Science Study Committee, p.152.

[45]Physical Science Study Committee, pp.152-161. The atomic and molecular nature of a gas, which cannot be demonstrated by neat, orderly patterns, reveals something about the nature of all matter because every solid or liquid can be made into a gas, and all gases can be made liquid or solid.

[46]Physical Science Study Committee, pp.429-437.

ral images in Ulysses. The kinetic model of gases can be applied to the earth and its atmosphere, and even further to the stars and universe as a whole. Thus, Bloom's statement in Lestrygonians (212), "Gasballs spinning about, crossing each other, passing. Same old dingdong always. Gas, then solid, then world, then cold, then dead shell drifting around, frozen rock like that pineapple rock", reflects the theory of gases: low temperatures favour orderliness and regularity; order is cold, disorder (chaos) is hot.[47] His statement is an explanation of the evolution of the universe from chaos (heat, gas) to increased order (cold) and eventual death through heat loss.[48]

That heat energy can be converted to mechanical energy (work) at the same rate of exchange at which mechanical energy turns into heat is the subject of the first law of thermodynamics (that energy is conserved); but, because there is a difference between transfers in the two directions, the second law considers how large a fraction can be converted.[49]

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[47] Entropy, a 19th century concept, is a statistical measure of the order (or randomness) of a system such as the universe; it measures the drift towards thermodynamic equilibrium.

[48] Theories of cosmic evolution were first developed in the 18th century by Thomas Wright in England in 1750, by Immanuel Kant in Germany in 1755, and by Pierre Laplace in France in 1796. Each attempted to trace the evolution of the solar system on the basis of the principles of mechanics. (Moulton, p.103).

[49] Physical Science Study Committee, p.436.

No single experiment can demonstrate this for the solar system as a whole because both initial and final states of the system would have to be known completely. However, at the end of the 19th century, some scientists believed that the solar system was rapidly becoming more ordered because the sun was cooling down. This idea spilled over into the earth and life sciences[50] through which it enhanced the general feeling of doom and of ending.

In Hades, the cemetery is the "gasworks", and death is related to gases: "Chilly place this. . . . Air of the place maybe. Looks full of bad gas. Must be an infernal lot of bad gas around the place." (130). The hydraulic heart-pump model here shows the connections between the theory of gases, heat loss, and personal, public, and universal death. "Broken heart. A pump after all, pumping thousands of gallons of blood every day. . . . Old rusty pumps." (133). This decay and rust rarely leave the atmosphere of Ulysses. The hell of Hades is extended to include the souls of all the departed, "Will o' the wisp. Gas of graves." (136); in Circe, the gassy souls become part of the

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[50] See Chapter II. Scientists now believe that were we to lose or gain as little as 10% of the sun's energy, we would freeze or burn to death, that life would be impossible on earth, and that were substantial amounts of energy disappearing, we would have felt the loss long ago. Similarly, there are no mysterious sources of gain. Cecilia Payne-Gaposchkin, Stars in the Making (Cambridge, Mass: Harvard University Press, 1952), pp.106-07.

universal process of "Metempsychosis. Spooks." The rusty pump reappears in Mananaan MacLir's hand as a bicycle pump with which air or souls are pumped into dead bodies in the hope of resurrection and to maintain a bizarre law of conservation such as Bloom's by which he visualizes the dead hunting around for their individual organs at the second coming. However, as is his wont, Bloom best remembers principles when he can associate them with his personal life; thus, he recalls that Molly gets gas after cabbage; later, he describes his passed wind as "Bad spirits".

The enthusiasm for experiment in the 17th century reached the proportions of a moral cause, and resulted in the founding of the Royal Society in 1662.[51] The spirit behind the movement towards empiricism and experiment was Francis Bacon whom Boyle and the charter members of the Royal Society clearly admired.[52] His analysis of the mind's innate blinders, or "idols", led to a proscription of system and an analysis of language which became important motifs in the science of the Enlightenment.[53] The "idols of the tribe"

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[51]Gillispie, pp.108-09. The French Academy of Sciences was founded in 1666.

[52]Gillispie, p.108.

[53]Gillispie, p.77. This analysis was particularly important in the Linnaean system of botanical classification and in the chemical revolution. The Linnaean classification related the form of the sexual organs of plants to their classification into classes, orders, genera, and species by a binomial system in which the noun denotes genus and the

are distortions arising from our natural inclination to see more readily that which we want to believe; the "idols of the cave" are simply our favorite prejudices and enthusiasms; the "idols of the market place", the result of association, are obstructions to the understanding created by a careless choice of words;[54] finally, the "idols of the theater" are the systematic dogmas of the philosophies.

The proscription of system, the analysis of language, and the later misunderstanding of Newton's "I frame no hypothesis" tended, however, to lead to a science consisting largely of an accumulation of detail, to natural history rather than to theory and abstract generalization; no discovery has ever been made by following Bacon's method ex-

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adjective denotes the species. Thus, the forget-me-not, the oreille-de-souris, and the vergissmeinnicht became the Myosotis palustris. (Gillispie, 170-71). In a similar manner, Salt of Venus became Copper Sulphate. (Gillispie, 169). Both analyses involve identifying the elements of a complex subject, then classifying them according to their logical or natural connections, and finally developing a nomenclature which assimilates the idea to the object.

[54]The identification of the error that results from an unfit choice of words was the first step to correction; the attempt to put precision into scientific language grew after Bacon, reaching its peak in the Enlightenment (and later in the Second Critical Revolution at the end of the 19th and beginning of the 20th centuries). This analysis was not restricted to scientific language, but carried over into other disciplines in attempts to make them more scientific or precise, especially once science began to be the generally accepted purveyor of truth. Saxe Commins and Robert Linscott, eds., Man and the Universe: The Philosophers of Science (New York: Washington Square Press, 1954), pp.87-105.

clusively.[55] Thus, Bloom's accumulation of facts about the stars, for example, without the necessary concommittant system is Baconian in fact, if not in ideal. This points to the unlikelihood of his ever coming to an understanding of the significance of the details he manages to accumulate, the meaning of the world he would so dearly like to have.

However, the goal of the New Learning was progress through the application of the inductive method to redress the empty rationalism of theoretical science, through the creation of a universal natural history, and through the public organization of science, in other words, "progress as this has been understood in the west ever since the 17th century, progress through technology and the domination of nature."[56] His classification of all history into civil (concerning human affairs) and natural (concerning facts of nature) contributed to the separation of science and the humanities, and his stress on the practical uses of science began the separation of pure science from technology.

Baconian science in connection with Bloom is thus critical. Bloom's inability to understand the abstract principles of physics is indicative of the separation of technology from science and the consequent lack of an instrument with which to critically evaluate the uses and effects of

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[55] Gillispie, p.82.

[56] Gillispie, pp.78-82.

the technology which runs his life. That he relies on science and technology rather than on religion, for example, reflects the separation of the humanities from the sciences as well as the fact that credible knowledge was increasingly thought to be attainable only through science. With Bloom, theoretical science becomes a kind of metaphysics which, because he is unable to understand it, leaves him without a comprehensive system through which to order and evaluate his universe. All the technology and all the detail in the world cannot give him this, and without such an understanding he is constantly at the mercy of his technology, without the power to change or control it. He is also left slightly empty, with a sense of longing, "Curious longing I".

In the 17th century, however, the Royal Society set the "tone and style" of science, and Bacon's insistence on the practical arts and on the public organization of science helped make it generally accessible to a lay public and, in some senses, responsible to it. In this, the Society helped to establish a scientific culture. Its most eminent member, Sir Isaac Newton, joined it in 1672 and became its president in 1703.[57]

Newton "united knowledge of heaven and earth in the structure of classical physics. For over two centuries that structure contained the thinking of a science which, no long-

[57]Copleston, vol.5, part I, p.158.

er struggling to be born, grew exponentially in vigor as in volume."[58] But the Newtonian cosmos wasn't the result of only Newton's thinking; rather, Newton drew from the discoveries of his predecessors and contemporaries. Inventor of the calculus,[59] discoverer of the composition of light and of the law of universal gravitation, he took the planetary laws from Kepler, from Descartes the argument that curvilinear motion involves the action of a force, from Galileo the notion that although science studies motion, what is more important to understand is change in motion, and from Huygens the idea that circular motion is inertial and centrally accelerated.[60]

Newton theorized that the motions of the planets around the sun are explicable through the action of a force exerted by the sun on the planet. He then applied this idea to the earth and moon, and eventually extended it to the motions of the comets and tides, and finally to the movements of terrestrial bodies so that celestial mechanics became one instance of inertial motion under a universal force law, the law of universal gravitation. In this way, he united physics and astronomy, separate since Aristotle, into a single science

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[58]Gillispie, p.117.

[59]Leibniz also independently invented a calculus.

[60]Gillispie, pp.120-1.

of matter in motion.[61]

Newton made Galileo's analysis, which had been restricted to certain simple motions, both quantitative and general by changing the emphasis from a study of motion as a whole to the study of the behaviour of motion from point to point along the orbit of motion. Through the calculus, he was able to precisely define the rate of change of distance along any point of the orbit when the intervals of length were allowed to become arbitrarily small. He could thus define the velocity along any point of the orbit, and given the velocity he could define its rate of change, or acceleration, at any point.[62]

The next step was Newton's mathematical expression of the force of gravity: every mass in the universe attracts every other mass with a force proportional to the product of the masses involved and decreasing as the square of the distance between them. Inserting this expression into the equation relating force to acceleration sums up the effects of the infinitesimal pieces of orbit. With this expression for gravitational force, Newton showed that the only possible particle orbits for one particle moving under the gravitational force of another (for example, the sun and a planet) are

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[61] Copleston, 5, I, pp.159-60.

[62] Bernstein, pp.31-2. Force equals the mass of the object multiplied by its acceleration, f = ma.

ellipses, hyperbolas, and parabolas. He thus recovered both the elliptical orbits of Kepler and the parabolic projectile orbits of Galileo.[63]

The consequences of these laws are profound: in Newtonian mechanics, the future path of a moving body can be predicted and its past disclosed if its present condition and the forces acting upon it are known. Thus, for example, the future paths of any particle or of all the planets can be calculated. This means that the entire future course of the universe is both fixed and, in principle, calculable.[64] Newton himself expressed the hope that all phenomena might eventually prove amenable to explanation in mathematical mechanical terms.

Laplace, in his Celestial Mechanics (1825), summarized the development of deterministic mechanics following Newton:

> We must envisage the present state of the universe as the effect of its previous state, and as the cause of that which will follow. An intelligence that could know, at a given instant, all the forces governing the natural world, and the respective positions of the entities which compose it, if in addition it was great enough to analyze all this information, would be able to embrace in a single formula the movements of the largest bodies in the universe and those of the lightest atom: nothing would be uncer-

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[63] Bernstein, pp.32-3.

[64] Bernstein, pp.31-3; Albert Einstein and Leopold Infeld, The Evolution of Physics (New York: Simon and Schuster, 1938), pp.62-6.

> tain for it, and the future, like the past, would be directly present to its observation.[65]

Upon this thinking Enlightenment optimism was based. The success of Newton's method meant the possibility of being able, through reason and correct method, to arrive at a completed science. As well, it meant that through knowledge and right education, man might also perfect himself and his institutions. Thus, the Enlightenment emphasis on language, its clear classification and meaning, was an extension of scientific method to domains outside science in the attempt to attain clarity and certain knowledge for these as well as for physics. This is the optimism to which Bloom aspires, but which he finds impossible to maintain for any length of time. He subscribes to the extension of physical principles even though he doesn't understand the principles themselves. He tries to take at face value the views based upon this science, but finds this increasingly difficult because the fallacy in this optimism—and it is one against which he struggles in others and in himself—is that man and nature are totally rational. Bloom discovers that they are not.[66]

Newton's conception of the scientific method comprised two elements: the inductive discovery of mechanical laws

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[65]Quoted in Bernstein, p.33.

[66]See Chapter II, pp.69-72 and Chapter III, pp.121-24. He struggles against irrational force in others in the Cyclops episode, in himself at the thought of Molly and Boylan.

from a study of the phenomena of motions, and the deductive explanation of phenomena in the light of these laws. Because he had inherited a strong empirical and experimental aspect to his thought from Bacon and Boyle, mathematics was, for him, the mind's tool or instrument in the whole process, not an infallible key to reality as it had been for Descartes and Galileo. In the third book of the Principia, Newton gave his rules of reasoning in natural philosophy. First, the principle of simplicity states that we ought not to admit of more causes of natural things than are both true and sufficient to explain their appearances. Secondly, to the same natural effects we must, as far as possible, assign the same causes. Thirdly, those qualities of bodies which are found to belong to all bodies within the reach of experiment are to be accounted the universal qualities of all bodies whatever. Fourthly, in experimental science, we ought to consider propositions based on induction from phenomena as being accurately or very nearly true, despite any contrary hypotheses, until such time as other phenomena occur which make the propositions either more true or liable to exception.[67]

Thus, Newton's statement, "I frame no hypothesis", was meant to get rid of unverifiable speculation which could never be experimentally verified; experimental verification

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[67]Copleston, 5, I, pp.160-1.

was thus the ultimate criterion for the validity of any hypothesis or proposition. For this reason, Newton never claimed to know the cause of gravity (although 18th century apologists later used gravity as an argument for the existence of God).[68] He was concerned with descriptive laws which state how gravity works, not with the essence of gravity nor with who or what put it there in the first place. He considered the forces of nature, of which gravity is one, as the "causes" of changes in motion, but these were not metaphysical causes either efficient or final; they were descriptive merely, the mechanical laws themselves.[69]

Newton's theory was regarded as weakening the extreme mechanism of Descartes' cosmos because gravity didn't seem reducible to the motions of material particles. In fact, Newton's critics regarded gravity as an occult force, a reversion to the innate tendencies Aristotle had put in bodies. Also, the void, which Newton introduced as the medium in which motion occurs, seemed to introduce the existence of the nothing, although Newton did not intend this as a metaphysical nothing. This medium was needed to answer the charge that gravity supposed action at a distance through a mystery rather than a medium. It was the complement of the ether which Newton had introduced to account for

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[68] Copleston, 5, I, p.159.

[69] Gillispie, pp.144-47.

the propagation of light across a distance because it was believed that neither motion nor light propagation could occur in nothing.[70]

Thus, Newton did frame hypotheses, but only to make his physics intelligible. He did not use them as qualities derived through methods of deduction and then say that they were the causes of phenomena. He insisted that natural science should derive two or three principles of motion from phenomena and then demonstrate how the properties and actions of all corporeal things follow from these principles, although the causes of those principles may not yet be discovered.[71] He thus continued the separation of science and metaphysics, the exclusion from science of the search for causes. Philosophers found it increasingly difficult to gain credibility for values or God, not only because these lacked any firm factual validity but also because they seemed superfluous to a successful scientific method.

Newton's theory of absolute space and time was also a speculative hypothesis. His distinction between absolute and relative time, and between absolute and relative space, although incorrect, was to last until the early 20th century. Indeed, absolute time became the common notion of time,

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[70]Gillispie, p.145; Copleston, 5, I, p.162.

[71]Copleston, 5, I, p.162.

linear rather than cyclical, that against which all events occurred.

> I do not define time, space, place and motion, as being well known to all. Only I must observe, that the common people conceive these qualities under no other notions but from the relation they bear to sensible objects. And thence arise certain prejudices, for the removing of which it will be convenient to distinguish them into absolute and relative, true and apparent, mathematical and common.
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> I. Absolute, true, and mathematical time, of itself and from its own nature, flows equably without relation to anything external, and by another name is called duration; relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by means of motion.
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> II. Absolute space, in its own nature, without relation to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces.[72]

Newton's absolute time forms a continuous sequence like the points on a geometrical line which succeed each other at a rate independent of all particular events and processes. It has neither beginning nor end, and would continue even were the universe completely empty. John Locke expressed the scientific conception in this way:

> Duration is but as it were the length of one straight line extended <u>in infinitum</u>, not capable of multiplicity, variation or figure, but is one common measure of all existence whatever, wherein all things, whilst they exist, equally partake. For this present moment is common to all things that are now in being, and equally comprehends that part of their existence as

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[72] Quoted in Gillispie, pp.141-2.

> much as if they were all but one single being; and we may truly say, that they all exist in the same moment of time.[73]

This common sense understanding of time was, until 1905, also the scientific understanding of time, linear and progressive. Although Leibniz, Newton's contemporary, had written that events are more fundamental than moments (the relational theory of time), this idea was not picked up in science until Einstein's Special Theory of Relativity of 1905. In Leibniz's view, moments are abstract concepts or classes of simultaneous events. He defined time not as a thing-in-itself but as the order in which things happen; that is, time is derived from events and not the other way round. In this way, two events are simultaneous not because they occur at the same moment of absolute time but because they occur together. This theory is closer to the modern scientific idea of time than is Newton's.[74] It is also closer to the time of Ulysses.[75]

Thus was the idea of cyclic time, of recurrence, which the ancients had held, lost in the advent of linear, scientific, progressive time; masses, having only primary

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[73]Maurice Cranston, ed., Locke's Essay Concerning Human Understanding (New York: Collier Books, 1965), p.127.

[74]Whitrow, pp.86-7.

[75]See Chapter II, pp.87-88.

qualities, moved in absolute space and time according to the mechanical laws of motion. But Newton, a religious man, was convinced that the cosmic order provides evidence for the existence of God. He seems to have thought that the motions of the planets around the sun were an argument for God's existence; he also argued that God keeps the stars at their proper distances so that they do not collide, and that God corrects irregularities in the universe. God thus not only conserves his creation but also actively intervenes to keep the machine going. Absolute space and time he interpreted as God's constituting of duration and space by his eternal omnipresence. Absolute space was God's "sensorium" in which he perceives and comprehends all things.[76] However, to deduce God from such things as irregularities is to push him further and further out of creation as these irregularities are found to be empirically and mechanically explicable. Once absolute space and time were abolished, even that source of explanation for God's existence was lost.

Nevertheless, from the publication of the Principia in 1686 until the end of the 19th century, Newton's mechanics remained essentially unchallenged.[77] His notions of

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[76] Copleston, 5, I, pp.165-6.

[77] Up to 1900, mechanics, now including celestial mechanics, was a formal development of Newton's laws by more sophisticated and rigorous mathematical techniques. Even other phenomena of physics (electromagnetism, heat, optics) were conceived of as extensions of Newtonian principles.

time, space, place, motion, force, and mass became fundamental elements of western culture. His science, and its method, reached not only an educated readership but also the general public through various popularizers of Newtonian thought as it filtered through the minds of Enlightenment philosophers and scientists.[78] The cosmos seemed stable, regular, and predictable. However, time, now linear and progressive, reached out to touch man himself and to tear away the last vestiges of his stable universe.

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[78]One popularizer whom Bloom mentions in Ithaca was Moses Mendelssohn, grandfather of the composer Felix. See Chapter II.

Chapter II

> The old Northern faith contained the fearsome doctrine of the dusk of the Gods. In our days there have arisen in more highly-developed minds vague qualms of a Dusk of the Nations, in which all suns and all stars are gradually waning, and mankind with all its institutions and creations is perishing in the midst of a dying world. . . .
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> Over the earth the shadows creep with deepening gloom, wrapping all objects in a mysterious dimness, in which all certainty is destroyed and any guess seems plausible. Forms lose their outlines, and are dissolved in floating mist. The day is over, the night draws on. . . . Dreams, which fill up the hour of darkness till the breaking of the new day, bring . . . . comfortless memories, high-souled hopes.[1]

The concept of degeneration was a commonplace in the second half of the 19th century. Originally a religious argument designed to explain the low place of savages and barbarian tribes in the human series, it became an anthropological explanation of the waxing and waning of civilizations. From this, it was extended to a psychological characterization of the fin-de-siècle.

A variant of Darwinian biology, degeneration was at a far remove from evolution as this had developed out of the scientific optimism of 18th century ideas of progress, that is, from the notion that man, even uncivilized man, was educable. The general 18th century theory of history had

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[1] Max Nordau, Degeneration, 2nd edition (1895; rpt. London: William Heinemann, 1898), pp.2,6.

functioned around a comparison of backward people to each other and to European civilization as this had developed up to the 18th century.[2] Such a reconstruction of the human past in a "natural" or evolutionary series of cultural stages was important to 19th century theories of progress and social amelioration precisely because it motivated action by its ethnocentric bias: Europe was the ideal, but through education, through the importation of European values and science, even barbarian tribes could be taught to rise above their sorry state.

But the idea of contemporary savagery as degeneration also had a long history related to the question of antipodal man, or man not of the seed of Adam, who would therefore lie outside the scope of Christian redemption. Early contacts with savage tribes had forced the question of the creative power of non-Christian societies to improve without assistance, and in the 18th century, anti-progessionist clergymen, committed to religious explanations of all earthly phenomena, considered savage societies as not merely static but as culturally regressing. Myths of fall from a golden ideal were perpetuated by voyagers who told of ruins of lost civilizations and of natives unable to reproduce the works of their forefathers. (For Rousseau, of course, degen-

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[2] Loren Eisley, Darwin's Century: Evolution and the Men Who Discovered It (1958; rpt. Garden City, N.Y.: Anchor Books, 1961), pp.337-341.

eracy was an explanation of civilization not of savagery.)[3] One of the most influential mid-19th century exponents of the degeneration theory was Richard Whately, Archbishop of Dublin.

According to Whately, original man was much as he is in modern civilization, with mental qualities not inferior to our own; aborigines, however, were the degenerate descendants of superior ancestors. Thus, man had not risen from savagery; he had sunk to it, particularly in those regions most peripheral to Europe. To prove this point, the sphinx lay brooding over fallen Egypt; the mathematical computations of the Mayan astronomer-priests were lost in the Guatemalan jungles.[4] Who, therefore, could say that whole nations and entire civilizations had not fallen, and would not fall, from their high estate? The fear that "if the past history of man has been one of deterioration, we have but groundless expectation of future improvement"[5] severely strained current ideas of progress.

Darwin's theory of evolution was itself in most ways not optimistic. The calculations of Thomas Malthus, advan-

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[3]Edmund S. Carpenter, "The Role of Archaeology in the 19th Century Controversy Between Developmentalism and Degeneration," Pennsylvania Archaeologist, XX, Nos.1-2 (Jan-June, 1950), 5-18.

[4]Carpenter, p.13; Eisley, pp.300-302.

[5]Lord Avebury, quoted in Carpenter, p.14.

ced in 1795, had determined the limiting ratio between any population and its subsistence: because population increases geometrically, food at best arithmetically, when the population increases beyond the point at which food is available to all, a "struggle for existence" will result which only the strong will survive.[6] This competition for life became the justification for 19th century conflict of interests as well as the moral foundation for liberal individualism. Lack of food helped to establish incentives to thrift, virtue, industry, and continence.[7] To this economic and social practice, Darwin gave a scientific biological basis: in growth and reproduction, variations arise by chance; and in the struggle for existence (based upon the food supply) favorable variations will be preserved through inheritance as the consequence of natural selection. In this way, new improved species will be formed and less improved ones destroyed. Those which (or who) cannot adapt to their circumstances are destroyed.[8]

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[6]Eisley, pp.53, 181-2, 331; Gillispie, p.311.

[7]Gillispie, p.311; Wylie Sypher, The Loss of Self in Modern Literature (New York: Random House, 1962), p.63. Sypher says that " . . . democratic freedom was only an abstraction for the self and society: it meant freedom for a single class. . . . Within the context of the majority, the romantic-liberal individual declined toward the mass man, and the technician became a culture-hero during the 19th century."

[8]Eisley, p.182; Gillispie, pp.311, 316-20.

> All the proverbs on profit and loss are there, from pulpit and from countinghouse—on many a mickle making a muckle? "Natural selection acts only by the preservation and accumulation of small inherited modifications, each profitable to the preserved being"; On the race being to the swift: "The less fleet ones would be rigidly destroyed"; On progress through competition: "Rejecting those that are bad, preserving and adding up all that are good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being"; On success: "But success will often depend on the males having special weapons, or means of defence, or charms; and a slight advantage will lead to victory"; On handsome is as handsome does: "Nature . . . cares nothing for appearances, except insofar as they are useful to any being"; On saving nine: "I could give many facts showing how anxious bees are to save time"; On reflecting that in the midst of life we are in death: "We behold the face of nature bright with gladness, we often see superabundance of food; we do not see or we forget, that the birds which are idly singing round us mostly live on insects or seeds, and are thus constantly destroying life; or we forget how largely these songsters, or their eggs, or their nestlings, are destroyed by birds and beasts of prey; we do not always bear in mind, that, although food may now be superabundant, it is not so at all seasons of each recurring year"; On the compensation that all is, nevertheless, for the best: "When we reflect on this struggle, we may console ourselves with the full belief, that the war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply."[9]

This is the doctrine that Bloom, who in his youth had avocated the "evolutionary theories of Charles Darwin, expounded in The Descent of Man and The Origin of Species" (Ithaca, 843), characterizes in his middle age, when explaining to himself the Jewish exodus from Egypt as: "And then the lamb and the cat and the dog and the stick and the

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[9]Gillispie, pp.301-02.

water and the butcher and he kills the ox and the dog kills the cat. Sounds a bit silly until you come to look into it well. Justice it means but it's everybody eating everyone else. That's what life is after all." (Aeolus, 155). At the Burton restaurant, seeing the "dirty eaters", he thinks, "Every fellow for his own, tooth and nail. Gulp. Grub. Gulp. Gobstuff. . . . Eat or be eaten. Kill! Kill!" (Lestrygonians, 216). When he is depressed at Paddy Dignam's funeral, he reverses the proverb: "In the midst of death we are in life. Both ends meet." (136).

This Darwinian system to which Bloom ascribes justice is, however, as a scientific theory, supposedly value-free, or independent of any morality. Clearly, however, if value is ascribed to those whom the system rewards by survival, then value is based upon strength simply because, as Bloom notices, the theory is dependent upon ability to gain sustenance. For this, both physical and economic power are required so that justice becomes proportional to money. Little wonder, then, that Bloom is careful with his. Survival also requires ruthlessness and, given that all cannot survive, justice may require killing one's neighbor, thus reversing the Judeo-Christian commandments to love one's neighbor and to not kill. The theory, therefore, is not value-free in its implications; rather than simply ignoring values, it helps to undercut them in any social system in which the theory is applied. Moreover, the theory denies

the possibility for physical resurrection, or metempsychosis, which Bloom thinks about throughout the day.

Applied to his own family, Darwinian principles become a blueprint for the degenerationist argument: his mother long dead, his father a suicide by poison, he considers his dead son, Rudy, "a mistake of nature" and his living offspring, Milly, "the same thing [as Molly] watered down". Evidently, his genetic stock is weakening, and favorable variations are not being handed down through inheritance. On the contrary, and directly opposed to Darwinist principles, what Bloom is afraid is being passed on are weaknesses, mental and physical. That he considers this his responsibility is indicated by his observation that if a child is born healthy it is the woman's doing; if not, it is the man's. The unfit are destroyed or destroy themselves as the consequence of natural selection, and because natural selection is the basic postulate for which the theory provides no final cause,[10] natural selection is simply a fact to be analyzed and not a cause to be wondered at no matter how evil or unjust it might suggest the "Selector" is. Stephen's mother also is dead, his father dissolute, his siblings in dire poverty; his comment is that his family belongs to "houses of decay, his, mine, all." (49).

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[10]Gillispie, p.318.

While Stephen applies the degenerationist argument to Ireland, Bloom applies it to entire civilizations:

> Things go on same; day after day . . . One born every second somewhere. Other dying every second. . . . Cityful passing away, other cityful coming, passing away too: other coming on, passing on. Houses, lines of houses, streets, miles of pavements, piledup bricks, stones. Changing hands. This owner, that. Landlord never dies they say. Other steps into his shoes when he gets his notice to quit. They buy the place up with gold and still they have all the gold. Swindle in it somewhere. Piled up in cities, worn away age after age. Pyramids in sand. Built on bread and onions. Slaves. Chinese wall. Babylon. . . . No one is anything. (Lestrygonians, 208).

His thoughts connect uniformity and anonymity to degeneration and death, both individual and cultural. He ties this idea to the notion that powerful civilizations are dependent upon the economic and moral enslavement of cities full of the anonymous; this is what the "dog eat dog" morality of Darwinian progress supports. Thus, in Ithaca, having no real security or belief in his Newtonian "metaphysics", Bloom wishes to become a property owner. However, the likelihood is that he will pass on with the rest of the anonymous poor because he has neither the physical strength, despite his exercises and diet, nor the genetic endowment through his family to "progress". The only way that he will ever gain enough economic power to break free is through a stroke of luck. Certainly, Bloom is unwilling to kill anyone in order to survive.

Max Nordau, in making the argument for psychological degeneration, regards it as "a morbid deviation from an original type [which] even if, at the outset, it was ever so slight, contained transmissible elements of such a nature that anyone bearing in him the germs becomes more and more incapable of fulfilling his functions in the world; and mental progress, already checked in his own person, finds itself menaced also in his descendants."[11] He relates this to the Darwinian formation of improved species by the comforting thought that this morbid variation does not "continuously subsist and propagate itself, like one that is healthy, but, fortunately, is soon rendered sterile, and after a few generations often dies out before it reaches the lowest grade of organic degradation."[12] The "germs" can be both physical and mental. With Bloom and Molly, the progress of this degradation is prevented by his impotence; he says he hasn't been "able to" since the death of his son Rudy. Bloom's concerns with diet and exercise thus take on added significance as does his reluctance to think bad thoughts and to have bad dreams, that is, to allow his subconscious to emerge.

The problem with this argument is twofold: first of all, it ignores Darwin's stipulation that variations occur by chance and, secondly, the fact that because evolution is a

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[11] Nordau, p.16.

[12] Nordau, p.16.

statistical as well as random theory, it cannot with confidence be applied to any particular individual, group, or nation a priori. And it is certainly illegitimate to argue from psychological causes in groups or nations to the physical facts of individuals (and vice versa). The danger of this type of argument is therefore obvious, and perhaps it is a vague comprehension of this danger which lies at the back of Bloom's mind as he tries to apply his brand of justice, love, to the anti-semites in Cyclops, and which causes his discomfort at the cemetery. Superstitions about race are underlined in the Harry Hughes song in Ithaca which makes use of the old legend that Jews use the blood of Christian children in the making of passover bread.[13]

Thus, the degenerationists inverted the evolutionary argument of survival of the fittest through natural selection, making moral and physical weakness a symptom of cultural regression, and cultural regression a sign of moral and physical weakness. The basis of their argument was religious, that is, it was an attempt to maintain the idea of special creation for man, but particularly for white, Christian societies, as though natural selection were a punishment visited upon peripheral peoples by some heavenly wreaker of vengeance

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[13]Richard J.H. Gottheil, "The Jews and Judaism," The Progress of the Century (New York: Harper and Brothers, 1901), p.530. Gottheil says that this old superstition, along with many others, was resurrected in the general wave of anti-semitism which took place in the last twenty years of the 19th century.

for the crime of non-Christianity. But Bloom has this argument covered; as a three-time convert,[14] he is, ironically, the one person in the novel who does his best to practice Christian charity. However, because the basis of the degenerationist argument was "difference from the norm", the norm being Europe, it was not difficult to see in any difference a cause or symptom of degeneration, and to extend this reasoning to individuals or groups within even a culturally

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[14] (Ithaca, 798). Bloom has converted to Protestantism from Judaism, and to Catholicism from Protestantism. "Bloom (three times) by the reverend Mr Gilmer Johnston M.A. alone in the protestant church of Saint Nicholas Without, Coombe; by James O'Connor, Philip Gilligan and James Fitzpatrick, together, under a pump in the village of Swords; and by the reverend Charles Malone C.C., in the church of the Three Patrons, Rathgar." In this, he has followed the example of his own father and of Moses Mendelssohn, an 18th century popularizer of German literature of the Enlightenment for the Jewish masses. "The new spirit was intensely modern, intensely cosmopolitan, intensely occidental, and intensely inductive. The Jews had preserved to a great extent their deductive, Oriental, particularistic, and ancient mode of thought and aspect of life." (Gottheil, p.513). Mendelssohn, a strictly observant Jew, felt the pulse of the new era, and entered upon the task of bringing a larger culture to Jewish masses. But his position was untenable because he was both Orthodox in matters of practice and had the attitudes of a modern German, holding that it little mattered what philosophical position a Jew held so long as he observed all the ceremonies connected with the faith. The irony being pointed to in Ithaca is that although he nurtured, through his disciples, a cosmopolitan spirit of practical Judaism, all his descendants became devoted members of the Lutheran church. (Gottheil, pp.513-17). Felix Mendelssohn Bartholdy, the composer whom Bloom mentions as an example of Jews who have attained eminence, was the grandson of Moses Mendelssohn, and was brought up a Christian. Thus, when Bloom mentions Mendelssohn as an example of "postexilic eminence" (805), along with Moses of Egypt and Moses Maimonides, the exile is clearly from his own religion and culture.

advanced nation. Thus, in Ulysses, Deasy can say that Jews "are the signs of a nation's decay. Wherever they gather they eat up the nation's vital strength" and can freely ascribe this to a mediaeval legend: "They sinned against the light. . . . And you can see the darkness in their eyes. And that is why they are wanderers on the earth to this day." (41).[15]

That such an argument had any credibility at all was partly the result of a forced retreat of evolutionists in the face of both a lack of paleontological evidence for human evolution and a lack of the time required for the

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[15]This is taken from the Mediaeval legend concerning a Jew who supposedly struck Christ on the way to Calvary and who was therefore condemned to wander throughout the world until Christ's second coming. But as Gottheil points out (pp.502-04), the Wandering Jew is not the Jew of legend, but the Jewish people of history who were forced to wander all over Europe in forced relocations whenever governments drove them out, or whenever persecutions forced them to leave to save themselves. Thus, "in 1899 and 1900 the hostility of the Roumanian government has made it impossible for thousands of Jews to remain in a country in which most of them had been born; and, under circumstances the like of which has hardly ever before been seen, bands of the Roumanian Jews have been wandering over Europe." (Gottheil, p.504). Bloom's father, who was from Austria-Hungary, had experienced dislocation from country of origin. Bloom, following his example, has culturally and religiously exiled himself from his past in order to assimilate into Irish society, but to little avail since around every corner he is confronted by prejudice. Stephen's exile is significant as an attempt to escape from history, that is, from both his intellectual patrimony, the Catholic church and Irish politics, and his physical patrimony, his family. But it is doubtful if he would be content to be forgotten like that other example of Irish exile, Kevin Egan.

human race to have evolved from its supposed anthropoid ancestors.[16] Without paleontological evidence, the idea of any kind of human evolution was difficult to sustain, given natural resistance to the idea, so that the special creationists could, for a time, deny the possibility of human evolution. This, and arguments concerning the secular cooling of the earth and the growing awareness of the second law of

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[16]Three papers of the physicist, Lord Kelvin, from the early 1860's, indicated that because the sun is an incandescent liquid mass which is dissipating its energy at a rapid pace, the sun's future energy is limited and in the past must have been hotter than at present. Thus, life on earth could not always have enjoyed the amount of heat and light it requires. In 1865, he attempted to demonstrate mathematically that the earth's crust cannot have maintained its heat stability over as enormous a range of time as the theories of the uniformitarian geologists and evolutionary biologists required. He insisted that his idea was enough to disprove the doctrine that transmutation of species has taken place through descent with modification by natural selection. Geological studies also tended to support the theory that the planet was cooling down, through its dissipation of heat from its molten condition, these results being obtained from studies of mine temperatures. (Eisley, pp.233-41).

Although "long before the clear recognition of fossil forms of man there existed in the minds of western Europeans a notion of racial gradiation, and a conception of that gradiation as leading downward toward the ape", no fossils existed to prove this one way or the other; until the skull of Neanderthal man was discovered in 1856, all theories of "ascent" or "descent" were dependent upon moral theories and comparisons of living human beings to each other. Even the Neanderthal skull remained "the butt of idle speculation as well as the product of disease" for over thirty years after its discovery. Neither the Cro Magnon nor the Neanderthal showed mental regress as rapid as had been expected, thereby disturbing the idea of continuity between man and apes. (Eisley, pp.264; 284).

thermodynamics, produced a reaction against the harsher aspects of evolution which, by not specifying man's existence from the beginning of creation and by not guaranteeing it in the end, had set man adrift in time just as cosmic evolution had set the solar system adrift; which, by forcing man to accept the fact that he must adapt to his surroundings and not the other way around, had in a sense reversed the technological argument for progress; which, by utterly removing the idea of a plan of design in nature leading to man, had put to rest, therefore, the possibility of postulating the existence of a creator from his creation.

The evolutionist retreat was due to the lack of the crucial mechanism of inheritance which remained unsolved until Mendel's work was discovered in 1901. So long as the mechanism remained uncertain, biologists (and others) could postulate unquantifiable modes for determining form, thereby involving themselves in teleological arguments from design or in speculations concerning the inheritance of acquired characteristics or habits.[17] This made possible arguments

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[17]Gillispie, pp.322-28; 330-34. Until Mendel applied mathematics to biology, that is, clearly demonstrated that the mechanism of inheritance could profitably be divided into "packets" which could be counted, arguments about heredity centered around "becoming" and around the "principle of unity" in evolution capable of differentiating living substance into phyla, species, organs, and cells. The reaction against Darwinian biology was based upon a distinction between physics and biology, that the laws of physics are different from the laws of life because they do not take into

concerning immorality weakening the nation's stock, incorrect because habit cannot be inherited. The reason given for the degeneration of Europe was based upon reading into a presumably observable phenomenon of fatigue the influence of a mythical cause or causes, either descent from peripheral (unfit) people, or excessive industrialization as a consequence of technology and inventions.[18]

In the 18th century, the model of a stable universe operating like a machine in absolute space and time, in which causes could be determined with certainty through the application of right method, had encouraged the notion that infinite progress was possible in unlimited areas. In the 19th century, this conquest of nature occurred, and in its turn encouraged a belief in the stability of the mechanical model of the universe. The overt sign of this progress was

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account "purpose" which to the organism is everything. To combat Darwin's impoverishment of biology, which fragmented rather than seized on its unity, biological romanticists (Nageli, Dreisch, Bergson) repudiated natural selection, which took away from humans the effects of will and purpose, and substituted for it an ideoplasm, an entelechy, or an élan vital, that is, a physical, formal, or immaterial unifying principle of continuity. However, "just as the discontinuity of atoms-in-the-void liberates motion from subjectivity, or indwelling qualities, so biological objectivity was firmly seated in the discontinuity of the hereditary patrimony whose inheritance might be comprised in number." (Gillispie, pp.341, 344).

[18]Nordau, p.40; Alfred Russel Wallace, The Wonderful Century (New York: Dodd, Mead and Company, 1899), pp. 343-68.

technological invention. And, because technology was successful, it, rather than pure science, remained in the forefront of public attention. In The Wonderful Century, a retrospective of the century's achievements published in 1899, A. R. Wallace's list of the century's successes runs from improved modes of travel and labor-saving machinery to astronomical and cosmic theories, ending with an assessment of these achievements in comparison to those of other centuries. The list includes 24 discoveries and inventions for the 19th century, 15 for all preceding centuries; of the 24, more than half are inventions. Even were the list an exaggeration, it reveals one 19th century attitude towards itself—science and technology, the method, had created an unparalleled achievement. Wallace's point is that the only basis for comparison is all, not any single one, of the preceding centuries.[19]

In Ulysses, each one of these inventions is mentioned at one time or another, usually in connection with the repre-

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[19]Wallace, pp.150-56. For the 19th century, the list includes the following inventions and practical applications: railways, steam-navigation, electric telegraphs, the telephone, friction matches, gas lighting, electric lighting, photography, the phonograph, Rontgen Rays, Spectrum analysis, anaesthetics, antiseptics. Wallace says the steam engine may be attributed to the 18th century although its principles were previously known. The telescope (and microscope) were 17th century inventions, along with the barometer and thermometer; printing was invented in the 16th century, the mariner's compass in the 14th, arabic numerals and the alphabet even further back in time.

sentative of the technological world, Bloom. But not only does Bloom mix up the principles of physics underlying the inventions; he also undercuts their original purpose. For example, at the cemetery, he thinks that a fitting purpose for the gramaphone would be to record the voices of those already dead, not simply to record the voices of the living for posterity: "Have a gramaphone in every grave . . . Put on poor old great grandfather . . . Remind you of the voice like the photograph reminds you of the face." (144). The telephone is a convenient way for Bloom to exercise his mnemotechnic by trying to remember telephone numbers. Birth pain reminds him not only of anaesthetics, or the "twilight sleep idea", but also of his father's death by poison. This systematic subversion of technology and its benefits points to a lack of consolation underlying the presumed advantages conferred by a society whose economic basis rests on them as well as to a certain lack of comprehension about just what these advantages are.

One thing is certain, however. Because the scientific method gave man the power to effectively invent anything he wanted,[20] it and the resultant technology seemed to take on a life of their own independent of any single individual or, for that matter, of all human life. Thus, Joyce devotes

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[20]Wylie Sypher, Literature and Technology: The Alien Vision (New York: Random House, 1968), p. 10. "The nineteenth century was a century of methodologies, in science, in history, in philosophy, in the arts."

an entire episode to parodying the reified method, and uses technology as subject matter as well. Bloom in Aeolus characterizes the press equipment as "Machines. Smash a man to atoms if they got him caught. Rule the world today" (150); he adds, "Now if he who runs them got paralyzed there and no one knew how to stop them they'd clank on and on the same." (151). Nevertheless, although he has doubts about what technology is actually doing, and despite the fact that he cannot remember accurately the principles upon which social improvements such as sewage systems are based, he does steadfastly try to believe that they could be applied to the benefit of humanity.

These inventions, which penetrated the life of almost every individual, also necessitated the extension of towns to accommodate industrial economies, and because the amount of work that mass-production required increased during the second half of the century, urban industrial populations grew tired. "This fatigue and exhaustion showed themselves in the first generation, under the form of acquired hysteria; in the second, as hereditary hysteria." The increased use of narcotics and stimulants to relieve these disorders themselves caused poisoning which taints descendants.[21] The large towns and cities, with their poor air and food, with their higher death rate for both adults

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[21] Nordau, p.40. (My italics).

and children, with all their nervous activity, created the environment for increased crime, madness, suicide, and new nervous diseases—"exclusively a consequence of the present conditions of civilized life". Both degeneration and hysteria are the results of excessive wear and tear suffered by nations through the immense demands on their activity, and through the rapid growth of large towns.[22]

Bloom, living in a large city in the midst of technological activity, thus has reason to fear narcosis, both intellectual and physical, as well as the committing of a crime (homicide or suicide) as the result of an "aberration of the light of reason", the aberration being "Newtonian" technology run wild. Perhaps he also fears the transmission of the defective mechanism which caused his father to commit suicide. That a young boy, whose father is drinking in the pub, smokes merely causes him to comment, "Let him. His life isn't such a bed of roses." At the chemist's, he thinks, "Drugs age you after mental excitement. Lethargy then. Why? Reaction. A lifetime in a night. Gradually changes your character" (104); this changed character will be passed on to one's descendants.

Although the degenerate supposedly suffered from various mental and physical disorders, his most distinctive feature was mysticism. In this state of mind, he "imagines

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[22] Nordau, pp. 41-43.

that he perceives or divines unknown and inexplicable relations amongst phenomena, discerns in things hints at mysteries, and regards them as symbols, by which a dark power seeks to unveil or, at least, to indicate all sorts of marvels which he endeavors to guess."[23] In the most commonplace and natural, he sees hidden signs.

Bloom, clearly, is superstitious, reading significances into coincidences; for example, seeing Parnell's brother and A.E. twice in the same day, he thinks, "Coming events cast their shadows." But superstition in this sense is not the same thing as mysticism; it is instead a parody of knowledge. As a parody of the inability to understand cause/effect relationships, it belies an insecurity about the statistical nature of events as presented, for example, in the random movements of gas molecules or in the idea that variations in species occur through random chance. If all cause/effect relationships are statistical, then betting on any particular horse to win a race is risking no more than leaving one's wife home alone all day on the chance that she will be seduced: one horse will win, and someone somewhere will be seduced. When knowledge and prediction are statistical, either event is only less likely, more likely, or improbable or probable, but not impossible nor

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[23] Nordau, pp.45-46.

certain.

Mysticism is also interesting in connection with Stephen, who despises the Platonistic poets of the opal hush ("Streams of tendency and eons they worship"), and who is a hydrophobe because he dislikes "aquacities of thought and language". His idea of artistic creation, which revolves around "signatures of all things I am here to read", involves not only a seeking for hidden correspondences between things but also the theory of art and perception at the center of his art, the "epiphanies on green oval leaves".

So long as the epiphany is an event dependent upon a relationship between the mind and things, the question of its objectivity resides not in a special luminosity within the thing but in the mind's focused attention upon that thing; that is, the validity of an epiphany is dependent upon the objectivity of perception, not upon the objectivity of things about which there is no question. That there is some doubt about the validity of perceptions is indicated by the device of parallax.[24] And, if perception is non-communicable or is a "private communication" through art or any other means, it is no different from any other mystical event. This calls into question what it is possible for either Bloom or Stephen to learn from the two times when a "reconciliation" between them, or their points of view, is

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[24]See Chapter III, pp.114-24.

supposed to occur, in Circe and in Ithaca, or even if such a reconciliation does actually occur. In any case, we are likely to base our decision, at least in part, upon the entire context of each character's psychology.

Stephen's psyche functions almost entirely upon his projecting onto the external world his inner world. Everything he sees in those episodes devoted to his stream of consciousness is, or reminds him of, the phantoms of his sorrow over his mother's death. The dream of his dead mother—"In a dream, silently, she had come to him, her wasted body within its loose graveclothes giving off an odour of wax and rosewood, her breath bent over him with mute secret words, a faint odour of wetted ashes" (10)—is the focal point of his consciousness; reminders of her emerge from the depths of his unconscious without his willing them. At the root of this is guilt, his guilt: "Her glazing eyes, staring out to death, to shake and bend my soul. On me alone. The ghostcandle to light her agony. Ghostly light on the tortured face. Her hoarse loud breath rattling in horror, while all prayed on their knees. Her eyes on me to strike me down. . . . Ghoul! Chewer of corpses! No mother. Let me be and let me live!" (10-11). This image, which colors all his perceptions (the sea becomes the bile she vomitted in her illness; his song is "Love's Bitter Mystery" in comparison to Bloom's "Love's Old Sweet Song"), he makes into something real, a reifi-

cation, by making her image the accuser when in fact her accusing eyes are his projection onto her image of his own guilty conscience at having refused to kneel and pray at her deathbed.

Her ghost, his guilt, is more real than anything else he sees, and indeed determines the way in which he sees and interprets things, others, and himself. The function of the mirrors and water throughout the first three episodes is to show that Stephen is not only self-conscious but also that what he thinks he sees is actually a reflection of his own mind, of his phantoms, of a fundamental uncertainty about himself which has caused him to create a persona separate from his real self or "soul". Thus, staring into the mirror Mulligan holds up, he says, "As he and others see me. Who chose this face for me? This dogsbody to rid of vermin. It asks me too." (5), and "In the bright silent instant Stephen saw his own image in cheap dusty mourning between their gay attires." (21). Exiled from others as well as from himself, he creates his proud persona to defend himself from his guilt and from what he considers Mulligan's offence to him.

The persona he chooses is the image of pride of intellect, of evil, the fallen Lucifer. However, underlying the image of Lucifer, "Allbright he falls, proud lightning of the intellect" (63), is not Satan but a vampire, a cliched parody of real evil. Most of the imagery

connected to Stephen's "satanism", probably acquired through his French symbolist connection, is of "feeding brains about me: under glowlamps, impaled . . . and in my mind's darkness of the underworld, reluctant, shy of brightness, shifting her dragon scaly folds" and of "vulturing the dead", that is, of wasting (Kevin Egan in exile, unremembered), of death (his mother), and of decay (his family, his culture: "Dead breaths I living breathe, devour a urinous offal from all dead." (63)). Even God's manifestation on earth is degraded: "God becomes fish becomes barnacle goose becomes featherbed mountain." (63). Christ's crucifixion is parodied in the Credo of Scylla and Charybdis: he is "nailed like a bat to a barn door." His protean poem, "he comes pale vampire, through storm his eyes, his bat sails bloodying the sea, mouth to her mouth's kiss" (60), of Eve falling to Satan, is expressed through vampire imagery, the image of emptiness, of something lusting for his substance. All this imagery expresses the general degradation of not only the trinity and the Christian concept of the fall but also of evil.

Thus, the question of the reality of evil, and therefore of the good, is central to Stephen, but it is an evil of the intellect, not an evil which he has knowingly or consciously accepted as residing in himself. He repeats the major fallacy of the Enlightenment which, in making God, nature, and man exclusively rational, also denied the real-

ity of evil. Any evil that exists, in this view, is the result of inadequate or incomplete knowledge; the corollary is that with complete knowledge, or God's perspective, creation would be seen to be good, and evil would automatically disappear.[25]

In this sense, aetheistic Enlightenment philosophy, in opposing traditional Christian theology in which man, after the fall, cannot but be evil, also denied the necessity of the crucifixion and of resurrection, "metempsychosis". Also, because science was the primary cause behind this view, the more it succeeded, the less necessary God became until he became a parody of his former self. Thus, in a fundamental sense, the "Word known to all men" which Stephen wants to know from his dead mother is "Yes" or "No": is there a God or not, are good and evil real? The answer, because it is not something for which one can demand empirical proof, can only be attained through faith; this is exactly what Stephen, as a lapsed Catholic, lacks, what he wants to lack. He himself says, "There is only one sense of the word" (23), that is, one either has faith or one doesn't. Stephen knows he doesn't, but seems unwilling to pay the price, insecurity, for his professed aetheism. He also doesn't seem to recognize the connection between this

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[25]This view is expressed succinctly by Laplace in his Celestial Mechanics. See Chapter I, pp.52-3.

and his search for the "Word", the true Logos or God. Thus, his statement to Haines, "You behold in me a horrible example of free thought" is ironic because, although he intends this to be taken literally, he actually is a horrible, that is, poor example of free thought. He is anything but free.

Stephen's unresolved guilt also points to one of the central problems of the novel—identity, his and others'. His practicing receiving applause in front of the mirror when he was younger as well as the self-conscious posturing of the entire Scylla and Charybdis episode in the library is an attempt to create a poised, proud self while remaining all the time the simple product of this guilt. And, because he cannot be certain of his own real identity without understanding his guilt, he cannot concede to others their identity except in the light of his own eyes. The reason he wants to escape history ("History is a nightmare from which I am trying to awake", 42) is to escape memory, but memory is what confers identity so that to escape time and memory he would have to escape himself; that is, he would have to do what is impossible except outside time. Thus, by emphasizing the "other I" (242), he attempts to cut his life, and identity, into spatial segments unrelated to time; however, when he says that in the "intense instant of imagination, ... that which I was is that which I am and that which in possibility I may come to be. So in the future, the sister of the past, I may see myself as I sit here now

but by reflection from that which then I shall be" (249), he is not abolishing time. Rather, he is becoming part of its flowing, succumbing mystically to it. Also, his soul, "entelechy, form of forms" (242), cannot be spatially divided because it unfolds in time; attempting to divide this into spatial segments would involve him in a situation akin to Zeno's paradox. The succumbing to time, the abolishing of past, present, and future by making them alike, places Stephen in the situation of indulging in precisely those "aquacities of thought" and Platonistic mysticism that he would like to avoid. Without doubt also, any epiphany that he participates in must involve a resolution of his guilt, and therefore of his identity; that is, it must occur through his mother and his religion. This is attempted in the Circe episode through the unconscious and the Black Mass, unsuccessfully.

Stephen, despite his willingness to escape time, cannot. Bloom, however, is another matter—he is always escaping time because he is in the middle of time: "Because life is a stream. Stream of life. . . . Can't bring back time. Like holding water in your hand." (Lestrygonians, 193). His feeling of time is not the common uniform Newtonian time ticking away against an absolute clock in the sky, but is more a function of his own attention. That is, when he is attentive, willing, the time he remembers is sky time,

for example, Molly's and Boylan's 4 o'clock assignation. However, more often than not, he forgets time (he forgets to eat on time; he loses his sense of time in the midst of music in Sirens) because in the middle of time he becomes mystically united with a force which flows on in things, in himself. He flows like water in the river, on the crest of the present moment, with the arrow of time which abolishes the sense of time passing. That the time may appear short or long indicates its essentially un-Newtonian, unquantifiable nature; that it "makes one" with process indicates its mysticism.[26] It thus involves a giving up or loss of identity which is conferred by memory acting through time; in this sense, loss of self is death.

That memory, time, is important to Bloom is shown by his attempts and resolutions to practice mnemotechnic, a conscious focusing of attention on whatever is to be remembered; memory, in this sense, is a function of the will.

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[26]Henri Bergson finds that reality is "given in immediate experience as a flux, a continuous process of becoming, to be grasped by intuition, by sympathetic insight, . . . that the multiplicity of conscious states is wholly qualitative. This unfolding multiplicity constitutes duration, which is succession without distinction, and interpenetration of elements so heterogeneous that former states can never recur. The idea of a homogeneous and measurable time is shown to be an artificial concept, formed by the intrusion of the idea of space into the realm of pure duration." Henri Bergson, Time and Free Will: An Essay on the Immediate Data of Consciousness, trans. F.L. Pogson (1889; rpt. London: George Allen and Unwin, Ltd., 1910), pp.x-xi, translator's preface.

With conscious willing, he is often unsuccessful. For example, he tries in vain to remember the name Penrose; later, when he isn't trying to remember it, the name pops into his head apparently of its own accord. This type of memory, what Proust called the involuntary memory, illustrates the role of the unconscious in the abolition of time and identity, through the flowing with time, la durée, and in the perfect blending of time past with time present.[27] This, although he doesn't seem to realize it, is what Stephen is aspiring to in his desire to maintain the spatial by abolishing the temporal. Bloom, despite himself, abolishes any spatial distinction between past and present, his past often becoming as real or more real than his present. He creates identities where none necessarily exist outside his own mind. That the source of this identity, the unconscious, is also the source of sexuality makes his amorousness understandable. And, because Bloom is a realist, not separate from his unconscious, idealistic relationships such as Henry Flower/Martha Clifford, and virginal statues such as the nymph do not have any power over him for long. This is the reason he checks the statues at the library to see if they are "real", that is, if they have anuses. In the end, it is to Molly, not to the sentimental sexuality of Mariolatry that is Gerty McDowell, that he goes home.

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[27] Shiv K. Kumar, Bergson and the Stream of Consciousness Novel (New York: New York University Press, 1963), p.25.

According to the degenerationist argument, the quality of attention is what determines the kinds of associations that are made: because attention is a function of will, the stronger the will, the more can be induced memory images and associations advantageous to the thinking, and therefore to the preservation, of the organism, and the more effectively can life-destroying ones be suppressed (repressed) in the unconscious.[28] Thus, a healthy, strong mind is like a room filled with daylight, in which all objects are seen distinctly and outlines are sharp, and wherein no shadows float. Attention, will, suppresses obscurity and phantoms. In the debilitated attention, judgment grows drifting and nebulous, lacking a central focus. The mind, straining to see, constructs phantoms which fool the conscious, rational mind, judgment then perceiving inexplicable relations between distinct phenomena and ambiguous formless shadows. In Circe, it is Bloom who, through memory and attention, breaks the spells of the various hallucinations, not Stephen whose resistance to his unconscious is impaired by alcohol.

At other times, however, Stephen is able to focus his attention whereas Bloom is distracted despite all his willing attempts. He frequently drifts off, especially when listening to music, then with a start realizes that

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[28] Nordau, p.55.

his thoughts are wandering almost of their own accord to places he would rather they not go. In Sirens, for example, the spell of the music is broken when the elastic band he is playing with snaps. All day, despite his conscientious efforts not to think about what he fears is to happen at 4 o'clock, his mind finds its way back to it, filling his imagination with thoughts in one way or another connected to the expected event. In this sense, Bloom, too, is a servant of memory, of time, and to be a servant of memory is in some ways to be at the mercy of one's unconscious, of the irrational, to be always close to the enticements of Circe where phantoms take on a reality otherwise denied them. With this, as with his "metaphysics" and technology, Bloom's life is somehow beyond his immediate control.

In Ulysses, the relationship between words and music in the songs that Stephen and Bloom each prefers is revealing of their attitudes towards what music does and of the connection of each to space and time. In Stephen's case, music also indicates his view of the artist and his creation.

In the Middle Ages, in religious music, the music was subservient to the liturgy; it was intended to reinforce the word of God. This meant that the musician, cantor and musicus,[29] usually remained anonymous, neither considered nor

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[29]The cantores only knew "how" the Pythagorean

considering himself an "artist" in the modern sense. For Stephen, the linking of religious ritual with art is significant because, in wanting to rid himself of the "priest" in his thinking, he is caught in the paradox of wanting to be a priest in another ritual, the artistic; that is, he sees the artistic process as akin to a religious rite of embodying the Word or Logos, and himself as high priest in this mission. In this, he is attempting to replace the religion of God by the religion of art, making analogous the relationship between God and his creation and the artist and his. In both instances, he is equally unsuccessful.

In the Ithaca episode, however, another type of ritual is connected to music and religion—ritual murder. The Harry Hughes legend is an ironic demonstration of the ambiguous nature of music itself, its harmonies capable of deceiving the ear, and of the relationship between words and music in song. That the legend is based upon anti-semi-

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ratios worked; the musicus also knew "why" they worked as they did. The role of the artist, both composer and performer, began to change when all music became secularized and began to have as its primary aim enjoyment for its own sake. Rather than being anonymous, he became important in his own right, his ritual artistic rather than religious. In the 19th century, secular music became almost a religion in itself, the musical artist a god, the relationship between the artist and his art analogous to that between God and his. The prime example of this phenomenon was Richard Wagner who in his music-drama attempted to combine myth, literature, drama, and music into a new religion with himself as its prophet. Bloom, characteristically, finds Wagner's music too heavy, preferring instead Mozart's 12th Mass as the epitome of its kind (Eumaeus), the older religion to the new.

tism is clear from the words which sadden Bloom. In the song, the all-important word depicts evil, while the music is the vehicle whereby aquacities are allowed to creep into the harmonic system. Whether Bloom understands the evil expressible through song is not clear—his Penelope is, after all, a singer—although, when he is saddened by songs, he does ascribe this to the words, not to the music ("So lonely . . . It all depends on the words"). He says that they are all about the same thing, unrequited or lost love, and feels that even if they are beautiful, they are too sentimental. His idea of music per se is that it is essentially mathematics or "musemathematics" and that anything can be done with arithmetic. That is, "music is not except in the strictest sense about anything;"[30] words and phrases are.

In the music that Stephen prefers, the relationship between words and music was considered ideal. His inclusion of Shakespeare's songs is obvious, and the music of Bull, Dowland, Byrd, and Tomkins (Eumaeus) was the acme of the English art song, the madrigal. These pieces are highly literary in that both words and music are important, the poetry abounding in classical allusion, thus preferable to a literary spirit. However, the growing influence of the science of the 16th and 17th centuries provoked a desire to

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[30] Martin Cooper, Ideas and Music (New York: Chilton Books, 1965), p.29.

introduce uniform standard musical notation which was accomplished by the staff and clef systems.[31] Before the bar system became common, music had not been strictly divided by number, vocal music having been based upon the natural accent of words, and instrumental music upon musical phrasing. Using exact bar lines changed the accentuation and rhythm of words and lines; one effect of this was that music, time, began to dominate the relationship.

Also characteristic of music since the development of harmony was the increasing complexity of harmonic progression, or modulation, from one key to another. The key system provided a strong tonal center from which it was possible to progress to increasingly remote keys through the circle of fifths,[32] whereas modal music had had to establish a tonal center by repetition. This characteristic, devloped as the result of equal temperament, enabled classical and especially romantic composers to "deceive" the ear which cannot discriminate changes in notation until a new tonality has already been established. In this way, it was theoretically possible to encompass in a single piece of music all tonality. The result is a merging of identities within a very large whole in which any identity can only be signalled through melody associated with a

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[31] See Chapter I, pp. 31-32, fn.30.

[32] See Chapter I, p.30, fn.29.

particular idea or character, that is, through leit motif.

The Wagnerian leit-motif is important in Ulysses as the paradigm for the stream of consciousness technique. Identity in music-drama is related to memory solely by association with a particular melodic fragment much as in Ulysses thoughts and memories are triggered by association with present events and objects. This is similar to Proust's distinction between the two types of memory, the voluntary and involuntary, the former the creature of will and reason, the latter a perfect blend of past and present. The difference in essence is that between mnemotechnic and free-association: Bloom consciously practices the first and usually succumbs to the second. Music thus informs not only the thoughts of the characters, Bloom's especially, but also the entire structure of the novel, and insofar as music lacks the spatial element, and contracts and dilates time, so in this sense is the novel a mystical novel in which past, present, and future dissolve into one single present.

Wagner in his operas took these musical possibilities to their limits, so that by the end of the 19th century "the musical language which had been slowly ripening for three hundred years had reached its term. . . . There could only be variety in the spending and enjoyment of accumulated wealth followed by the gradual contraction and final decay of the language . . . of tonality—the crux of

the whole 'linguistic' problem."[33]

One effect of this tiring of the tonal language was that composers began to turn towards extra-musical sources for their ideas. Another was the movement towards exotic, eastern elements and "new-old" scale systems. Even while the symbolist poets were influenced by music, Wagner's especially, aiming to have poetry approximate the consummate art, composers were looking towards poetry as a source of new forms.[34] Because tonality had been almost dissolved, larger musical structures lost their shape and sense of direction; the composer turned to smaller forms in which color and texture became the primary concern, and in which the evoking of moods was frequently accomplished by the use of exotic scales such as the whole tone, or old

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[33]Cooper, p.16.

[34]The Symbolists were profoundly affected by Wagner's music (Cooper, p.17). Baudelaire had proclaimed a "correspondence" or synesthesia between the arts in which "scents, colours, and sounds echo each other." (Quoted in Cooper, p.29). In England, Walter Pater wrote in 1889 of music as "the typically perfect art . . . the ideal of all art whatever, precisely because in music it is possible to distinguish the form from the substance or matter, the subject from the expression." (Quoted in Cooper, p.30). Verlaine's poetry praised musical beauty before all else, as having "the power of suggestion rather than a statement of fact, the wedding of the precise and the vague in the choice of images, and the employment of shades (nuances) rather than brilliant colours." (Quoted in Cooper, pp.30-31). Holbrook Jackson makes a similar point about painting in The Eighteen Nineties (New York: Capricorn Books, 1966), as does Arnold Hauser in The Social History of Art, vol.4 (London: Routledge and Kegan Paul, 1962), p.183.

scales such as the pentatonic, or by mystical chords.[35] Small forms took precedence over larger structures; songs and operas were favored because the music in them was not required to stand alone.[36] In this, the Harry Hughes song is a parody of the condition of music at the end of the 19th century: the individual qualities of the two modes, major and minor, are fused together, each taking on the character of the other; the harmonic progressions are confused; and it contains a grotesque interval which would horrify any singer.[37] Music, therefore, and all that it represents in Ulysses is also amenable to the degenerationist argument.

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[35]Debussy's music is written in whole tone; Scriabin used a mystical chord which he linked to colors; eastern European music is frequently pentatonic.

[36]Cooper, p.17.

[37]The tonality of the Harry Hughes legend is somewhat strange: the first several bars of the "major" part of the song have a clear tonality (D major) and the progressions are simple (I-V-I-IV, that is, tonic to dominant to tonic to subdominant), the modulation being related to the subdominant. However, the character of the music is strangely minor where it ought to be clearly major. In the second, or "minor" part of the legend, the music is clearly major where it is supposedly the minor part of the legend.

Music, because it lulls the attention and the will, not only of individuals but also of nations, is a mystifying influence. Succumbing to music is, therefore, a succumbing to time, to memory, to the stream of life, to non-identity, to death, to the "twilight sleep idea". It means preferring the East to the West, the lotus to the cross, the fin-de-siècle to the new century. As a synonym for cultures and civilizations, it means degeneration and decay, the "dusk of nations". Refusal to succumb, insistence on maintaining the spatial by abolishing time, means living in a paradoxical timeless present without memory. Culturally, it means abolishing history, forgetting the past.

Chapter III

Marshall McLuhan has suggested that it is possible to gain a meaningful understanding of Ulysses by tracing the traditional mediaeval disciplines of the trivium (grammar, logic, rhetoric) and quadrivium (arithmetic, geometry, music, astronomy) through the novel.[1] Although it is possible to follow the development of each of these arts individually through the novel, this is something well beyond the scope of this thesis. However, in this light one can interpret the episodes in which Stephen and Bloom are seen together as moving toward an attempt to unify the mediaeval seven arts into their ideal, a viable theological and philosophical world view. In the Circe episode, this is attempted through the unconscious and its modes of action, the irrational and the intuition. The result is hallucination which cannot be sustained and a false epiphany. In the Ithaca episode, the self-styled emissary of the trivium, Stephen,[2] meets the modern representative of the quadrivium, Bloom, under the auspices of the modern scientific sensibility.

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[1] McLuhan, pp.2-3.

[2] Stephen boasts of having read St. Thomas Aquinas' works in the original. Mulligan claims to have "called upon the bard Kinch at his summer residence in upper Mecklenburgh street and found him deep in the study of the Summa Contra Gentiles in the company of two gonorrheal ladies." (264,275).

Joyce establishes within the first several questions that the four arts are under consideration: geometry ("the chord of any circle being less than the arc which it subtends"); music ("both were sensitive to artistic impressions musical"); arithmetic (the list of dates of Bloom's previous "nocturnal perambulations"); astronomy (the answer to the question "Were their views on some points divergent?" in which Stephen invokes parallax as the explanation of their differing viewpoints).

That the quadrivial or scientific sensibility governs such a crucial episode of the novel—the reconciliation so often looked for by critics—is an indication of the extent of the incursions that the sciences had made into the domain of the "trivial" arts. A "straight" reading of the episode would leave the matter there, with the conclusion that this sensibility is the most important subject of parody, and it is true that much of the irony of the episode does function around this disembodiment of the questing scientific method. However, what is more interesting is that in this episode the so-called quadrivial arts are themselves shown to be decisively undermined until, in the end, there occurs not a reconciliation of the "trivial and quadrivial" into a stable philosophical and theological world view, but the reverse, its dissolution into the mystical or superstitious equivalent: mathematics becomes numerology, astronomy astrology, and musical harmony an undistinguished

diminished seventh. All stable foundations for perception and knowledge are thus undercut. The circle (trivium) is not squared (quadrivium), three plus four do not add up to seven.

Joyce's embedding of his ideas within the framework of the mediaeval disciplines is a signal that once again, by analogy, a major change was taking place in the European world of the late 19th and early 20th centuries. In this sense it is possible to interpret the Middle Ages as having been dominated by the trivium, with the four practical arts playing a subservient role due to their primitive state at the time. In the Renaissance, with the "take off" of science, occurred the separation of these two ways of knowing, with the quadrivium becoming increasingly dominant so that after Newton science was often, if not usually, considered the only credible source of knowledge. By the 19th century, the scientifically-dominated world view had thoroughly saturated and undermined the credibility of all knowledge acquired by methods other than its own. Thus, when Newtonian science itself began to lose credibility, partly as a result of its own method, the world view based upon this science was also bound to disintegrate, thereby making the situation analogous to the dissolution of the stable mediaeval world view. In such a situation, causality, and therefore knowledge, were left in limbo; the main artistic re-

course for depicting this change was irony.[3]

While this analogy between disintegration of worlds and of "history repeating itself with a difference" is overly schematic, it does give an indication of the larger movement or "gesture" of the novel; more than that, it is supported by the text. The Eumaeus episode prepares the reader for a central point of Ithaca—the determination of whether or not this analogy is a true one. In Eumaeus, the problem of analogies focuses around false identities, lies, mistakes, and coincidence: these demonstrate that analogies, because they are necessarily partial, may also be false. WB Murphy lies about having seen Simon Dedalus, or someone with his identity, touring with a circus ten years earlier. While some of Murphy's circumstances seem to correspond to Ulysses' (for example, he hasn't seen his wife because he has been sailing around the world for seven years), the most important thing about the comparison is false—the name and address, that is, the true identity of the man. This throws everything else into doubt. Bloom, somewhat confused,

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[3] Nevertheless, at the same time, the materials for making a new statement about the physical universe were everywhere present. The problems with Newtonian absolute space and time, for instance, finally received a new philosophical formulation in Einstein's ("Dr Winestain's") Special Theory of Relativity of 1905. Joyce's choice of June 16, 1904 as the date of his epic was, therefore, an auspicious one from this point of view. The modern psyche and the modern conception of time and space as represented by Bloom are seen for the last time in the deep night of Ithaca, just before dawn (!).

ascribes the incident to coincidence because "life was full of a host of things and coincidences of a terrible nature" (735), but considers that the whole thing might be possible: "Mind you, I'm not saying it's all pure invention . . . Analogous scenes are occasionally, if not often, met with" (735-6). The warning, then, is that the reader ought to be wary of analogies, especially of those involving dubious identities.

The Ithaca episode itself contains several false analogies by which both artistic and scientific metaphors are subverted. For example, not only does Molly confuse sound with spelling, time with space, ("alias" and "met him pike hoses" for Elias and metempsychosis), but she also combines this with false cause or superstition in telling her fortune by playing cards. The analogy of Moses of Egypt, Moses Maimonides, and Moses Mendelssohn as examples of "post-exilic eminence" (805) points out that the basis of analogy is identity and that even parallel events (exile) and a partial identity (the same first name) may result in a false analogy or faulty conclusion because Mendelssohn, unlike the others, converted to Christianity. The comparison of Milly and the cat (when his cat wants to be let out of the house, he thinks of Milly's leaving home "because actuated by a secret purpose the quest of a new male (Mullingar student)" which he considers similar to the cat's hunting for valer-

ian, but different "because of different possible returns to the inhabitants or to the inhabitation", 813) is a parody of analogy by function which operates by "animalizing" humans, in the same way as he had earlier "humanized" the same cat. Obviously, this analogy functions around false identity. The analogy between woman and the moon (823-4) extends the concept of false analogy to literary metaphor. Because it follows immediately upon Bloom's meditations, it indicates an extension of their results into areas apparently far removed from science.

All comparisons are thus made suspect through the undermining of analogy, both scientific and literary. This indicates that as metaphors or paradigms lose credibility, they may be perceived as false analogies. Even seemingly invincible scientific models are seen to be "mere" metaphors once they are factually no longer valid. The reader is thus left to conclude that differences may be more significant than similarities and that he draws analogies at his peril, although he is frequently invited to do so. It is precisely the nature of these difficulties which prevents the analogy between the changeover of the mediaeval to the renaissance world, and the Newtonian to the modern, from being taken as a homology.

Where the major difference lies is in the relative importance of science, of the scientific way of knowing, in

the modern as compared to the mediaeval world. For this reason, the problem with analogies points to the difficulty of maintaining that any unification of perception and cognition takes place because it precisely these that the rise of science affected. When identity and cause cannot be determined with any certainty, agreement about perception and knowing becomes problematical at the very least. If, therefore, a reconciliation does occur, the chances are that it can only take place mystically and cannot provide any knowledge that can be shared. Even the mystical solution to this problem via the construction of the New Jerusalem using the quadrature of the circle as its basis has been ruled out.[4]

The question and answer format of the episode reads like a student's science textbook. The questions, written

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[4]The Circe episode eliminates the possibility of constructing the sacred city through the mystical route. The only city constructed is the kidney-shaped New Bloomusalem whose shape does not correspond to that accorded the mystical city in Revelations and in sacred geometry. The "parabolic pathways" of Stephen's and Bloom's urination in Ithaca indicate that the same problem is being pursued in another way, and equally unsuccessfully. In Ithaca, the "secular" problem of the squaring of the circle is not solved either. Kepler, too, had attempted to unify all knowledge in his harmony of the universe, but that also was an unsatisfactory mystical solution undermined by science. Interestingly, Kepler held that his reason for agreeing with Copernicus that the sun was at the center of the universe and for being able to extend this to his laws of planetary motion was that the picture created in this way was a perfect analogy with the holy trinity. Arthur Koestler, The Act of Creation (London: Pan Books, 1970), pp.124-30.

in the scientific vocabulary or jargon of the particular discipline that is at any moment being evoked, are so phrased that they can be answered in any one of a great variety of ways: the questions are general and abstract, supposedly value-free or "without bias" so that they will not elicit the answer that is required; that is, they purport not to indicate the correctness or incorrectness of any particular approach. The intention in framing very general questions in science is to include as many classes as possible in order to obtain the widest possible framework of applicability of the resulting information. But beyond a certain point, the answers become meaningless precisely because so many are possible; the primary level irony of the episode functions around this ambiguity. For example, in the water sequence (782-4), the exhaustive (and exhausting) answers to the questions "Did it flow?" and "What in water did Bloom, waterlover, drawer of water, waterdarrier returning to the range, admire?" take us around Dublin's waterworks and to "faded flowerwater, stagnant pools in the waning moon" in their labyrinthine consideration of detail and in their desire to be complete. Most of the answers to most of the questions usually answer more, or less, or other, than the question asked.

Thus, one of the effects of this type of generalization is the loss of the individual identity of any particular object included in the scientific description of

any particular class of items, and a general lack of a sense of direction in the information given out. Moreover, the part of an object upon which comparisons to other objects are made becomes a substitute for the entire object because the ideal of this science is the reduction of all natural phenomena to a single description or law. In this, science is no different from a seeking for a mystical "one" because ascending the scale of nature to the most general of necessity involves abstracting to the "n^{th}" degree until the classes of objects have no content left.[5] This is simply another way of putting the problem posed by Stephen's feeling of emptiness in the imagery of vampires. Bloom, at the cemetery, also considers that the punishment for suicides such as Virag is driving a stake through the heart. This connection indicates that the identity of the vampire might to a limited extent be scientific because it is science which has emptied the world of its concreteness and of its "sacramental" nature. Wylie Sypher mentions the functionary, Ulrich, in Robert Musil's The Man Without Qualities, as portraying this very problem. As men are considered in larger and larger groups defined by some similarity or other, the only statistic that seems to matter is the mean or average. The result of this is twofold: the disappearance of individual characteristics, and the shifting of the

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[5] Ernst Cassirer, Substance and Function (New York: Dover Publications, 1953), pp.6-7.

self's center of gravity outside the self.[6] This result is inevitable when classification according to one similarity is combined with the weight of statistical mathematics.

The lack of a sense of direction originated in the ideal of objectivity in which the observer was to remove himself from the picture so as not to "frame hypotheses", that is, not to have any "idols" that would stand in the way of attaining the "truth".[7] Carried to extremes, this becomes a subject for parody. Hugh Kenner, in Joyce's Voices, has written about the cult of empiricism and objectivity in Gulliver's Travels, saying that Gulliver's awakening in Lilliput is an illustration of narrative controlled by the objective or empirical discipline:

> The narrator tells in minute detail exactly what he sees in the order in which he would have seen it were he tied in the same position; we are told

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[6] Sypher, Loss of Self, pp.45-49.

[7] After the Copernican revolution dethroned man from his position at the center of the universe, the emphasis on "holding the mirror up to nature" further endistanced the observer from the objects of his observations. The development of perspective technique was also important in this connection because it fostered belief in a unitary perspective based upon focal point. (Sypher, Literature and Technology, pp.34-35). The deliberate cultivation of objectivity arose with the realization that we all too easily project into the world what we wish to find there; the aspiration towards the ideal of completely value-free neutrality was the result. (Herbert J. Muller, Science and Criticism (New Haven: Yale University Press, 1943), p.85).

> only those things that an observer would have experienced in the order he would have experienced them. And the report is equated with the discrete reports of the senses. This is objectivity: the outer world conceived as a sequence of reports to someone's senses, and a sequence occurring in irreversible time.[8]

The Ithaca questioner-persona attempts to follow this rule as well, but just as Newton, despite his rule of "I frame no hypothesis", could not altogether avoid forming them, this persona must ask questions in a prescribed order to be at all intelligible. Thus, both the method of objectivity and reduction by classification must be referred to something else, or to someone else. That is, "the selection of what is common remains an empty play of ideas if it is not assumed that what is thus gained is, at the same time, the real Form which guarantees the causal and teleological connection of particular things."[9] This is the notion floating above both Bloom's head and Stephen's, that is, the nature and identity of this "Selector" or God. Bloom believes that there is a scientific metaphysics that is the function of a "superior intelligence"; Stephen wants to know if it is possible for someone to know or see all, that is, if there is a god, and what precisely it is that determines development or form.

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[8]Hugh Kenner, Joyce's Voices (Berkeley: University of California Press, 1978), p.10.

[9]Cassirer, p.7.

The danger of the scientific method lies in the possibility of confusing what can be only a partial explanation of the world with a complete statement about it, of extending the method into areas where it doesn't belong. For example, the demands, "prove that Bloom had loved rectitude since his youth" and "reduce Bloom by crossmultiplication of reverses of fortune" demonstrate the application of the scientific method and style to situations inappropriate to such examination: they demonstrate the perils of extending the scientific analogy to other areas of the world. Thus, the possibility for attaining a unified, endistanced view, long held to be possible with the neutral observer, is now, according to Bloom, possible only for the superior intelligence or God so that the Newtonian metaphysics to which he refers all questions is increasingly unable to provide him with any answers, not least of all because he doesn't understand its principles but because, by definition, these principles would be inaccessible to him. To Stephen, the artist, who replaces God, therefore must know all to say anything.[10] Thus, the narrator-persona is sometimes intel-

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[10]Both author and reader have a broader perspective than either character or the narrator: the reader occupies a place equal but opposite to that space where the artist resides, "paring his fingernails". The larger and more unitary the vision, the more closely does the artist approximate the condition of God. M. H. Abrams, The Mirror and the Lamp: Romantic Theory and the Critical Tradition (New York: W. W. Norton and Co., 1958), pp.238-41.

ligible, sometimes not. Sometimes he initiates the response or action; sometimes he merely follows Bloom about the house with his measuring eye.

Furthermore, the words "prove" and "reduce" mean one thing in a mathematical context, quite another in the context of Bloom's fortunes; we can, therefore, conclude that Joyce's intention was not only to demonstrate that this type of objectivity was no longer credible in all instances but also to indicate something about the nature of language itself. Throughout the episode, we can see that moods of weariness and dejection slip in regardless of any attempts to be totally objective by using neutral language because even the most neutral and colorless language is not entirely free of connotation either personal or public. For example, the scene Stephen constructs after Bloom's reciting of the rejection of his advertising scheme (an illuminated showcart containing two smartly dressed girls writing) is given in the most simple words: "Solitary hotel in mountain pass. Autumn. Twilight. Fire lit. In a dark corner young man seated. Young woman enters. Restless. Solitary. She sits. She goes to the window. She stands. She sits. Twilight. She thinks. On solitary hotel paper she writes. She thinks. She writes. She sighs. Wheels and hoofs. She hurries out. He comes from his dark corner. He seizes solitary paper. He holds it towards fire. Twilight. He reads. Solitary." (800-01), yet the mere repe-

tition of the words "solitary" and "twilight" as well as the sequence of events sets up in the reader's mind a train of associations not very different from that resulting from Bloom's scientific description of his father's suicide alone, although the language and the mentality appear to be quite different. The mere fact of a note containing the words "Queen's Hotel" are enough to foster this connection. Thus, so long as scientific description is done in words, or so long as language attempts to be science, one will of necessity color the other, for such is the nature of language and of thought. Scientific description need not include overt value-judgments; these values are contained within the language itself. The same is true of the attempt to unite the trivium and quadrivium through words and music in song. The result is the Harry Hughes song.

Thus, the connection between trivium and quadrivium in the Middle Ages was language. Aristotelian science was itself linguistic, being based on classification and division of substances, and on the syllogism, that is, on relations amongst terms, propositions, and propositions acting as terms.[11] But the mathematicization of nature which began in

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[11]This is the basis of, for example, Linnaeus's system of botanical classification which became impossible to maintain insofar as it reflected a static order. The physical equivalent to this was of "ever dividing until nought nowhere was never reached" (Zeno's paradox). Thus, Stephen, insofar as he is "mediaeval", represents a static, spatial view of language, a language of nouns rather than verbs. This is

the renaissance also began the movement away from a linguistic representation of reality to a symbolic one, gradually moving towards the concept of function, not substance, as the model of nature.[12] As science and mathematics gained in credibility, language in all its forms began to be affected by an increased awareness of the role that it plays in thinking. Thus, in the modern equivalent to the changeover from the mediaeval to the renaissance world, perhaps the major difference in the analogy is the substitution of mathematics, symbols, for language, or the creation of a symbolic language. This relationship is indicated in the similarity between "polysyllabax" and "parallax", the former referring to languages, the latter to science. Thus, Bloom has reason to feel insecure about mathematical reality because he has difficulty even calculating barrels of porter, much less understanding its symbolic significance.

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the reason for Stephen's dislike of "aquacities of language or thought". Water, as the "universal solvent", is thus "paragon and paradigm" for the water-loving mystical Bloom, but causes Stephen's "hydrophobia". Thus, not only was the teleology of Aristotelian science problematical but also his concept of substance. The later concepts of "gravitational force", "ether", and "void" created similar difficulties. The concept of substance has effectively disappeared from post-Newtonian physics; only relations remain. The linguistic equivalent would involve a shift from nouns to verbs as the primary form of expression.

[12] Cassirer, p.20.

Parallax, the device whereby a reconciliation of Bloom's and Stephen's viewpoints will occur, if it occurs, is an optical phenomenon used in Ulysses as a supposed corrective to misperception and as an ironic "guide to true knowledge". This relationship between perception and knowledge is represented in the imagery of mirrors and lenses through which the phenomenon of parallax is effected. Parallax thus functions as a structural device connecting various perceptions and misperceptions through which any reconciliation other than the mystical must be effected.[13] Ulysses is replete with references to lenses (both eyes and eyeglasses), mirrors (both concave and convex), microscopes, telescopes, and cameras, that is, to objects which are, supposedly, the cause of; or aids to, distorted, or clear, natural vision.

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[13]Thus, it is established immediately in the Ithaca episode that the same event (the collapse of Druidism and the conversion of the Irish nation to Christianity) is interpreted in two very dissimilar ways: by Bloom as "gastric inanition . . . accelerated by mental exertion and the velocity of rapid circular motion in a relaxing atmosphere"; by Stephen as the "reapparition of a matutinal cloud . . . at first no bigger than a woman's hand". (777). The two have observed this cloud earlier in the day from two different points of observation, and the problem is to reconcile the materialist view of cause (diet and alcohol) with the artistic image that Stephen presents. But Bloom cannot maintain his scientific viewpoint consistently: he is depressed or bothered, despite his adherence to a dietary regime, despite his adherence to the old adage, "man does not live by bread alone". Stephen, who hasn't eaten since the day before yesterday, must eat something or collapse, despite his adherence to the changed adage, "man does not live by bread at all".

The first episode of the novel indicates that mirrors are to be important to most of the major themes of the book. Mirrors are everywhere connected to dual viewpoints and perspectives—in this instance, Stephen's and Mulligan's,[14] later Stephen's and Bloom's—by which the problems of self-identity and others' perceptions of this identity ("As he and others see me") are expanded to include nature, pride, and usurpation, and by which the theme of paternity for both individual and family is expanded to include the divine family, the holy trinity. It also includes the identity of the artist in the creation of his work in which the ritual of art is likened

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[14]Mulligan, with his "I remember only sensations and ideas", is in the optimistic side of the Enlightenment scientific, psychological, and philosophical tradition. He represents the strictly mirror view of nature (and art). Bloom is much more because much later; he cannot hold the same assumptions as Mulligan, at least not consistently; even though optimism is clearly his preference, he fears losing the light of reason. His inclination to loneliness, depression, and feelings of being overwhelmed indicate that it was no longer possible, in 1904, to hold the optimistic, progressive view of reality exclusively. The major difference between him and Mulligan, whom he does not admire despite his being a medical doctor, is the importance of evolutionary ideas and music, that is, time related ideas, and perceptions dependent on senses other than sight. The romantic, organic view of life bothers Bloom all day and, in the evening as well. Stephen, too, is fond of music, but is more able to understand its siren charms. Bloom, "victim predestined", simply suffers its physical and emotional effects, and reacts by removing either his physical or emotional presence, his body or his thoughts, from these effects. His solution is a commonsense one based on will.

to the place and nature of God in his creation of the world; both are removed. Mirror imagery is as important to Stephen's viewpoint as it is to Bloom's, although each approaches his concerns from different angles.

In Lestrygonians, Bloom is also concerned with identity ("See ourselves as others see us"), but his approach is different from Stephen's. Bloom is curious to find out how others see him, that is, he is concerned with outside opinion, whereas Stephen, in his arrogance, knows, or thinks he knows, how others see him. Bloom's curiosity expresses itself, as usual, in means physical. When he holds out his arm to block the sun with his finger and then asks himself "What's parallax?" (211), he is "almosting it". Were he to close first one eye and then the other, he would see parallax in action as his finger moved against the fixed background of sun and sky. When he thinks "parallel, parallax" (194), he is close to the physical solution of the phenomenon.

According to Newtonian optics, when parallel beams of light hit a curved lens surface (eye, glasses, camera, microscope, telescope), they converge or diverge depending on whether the curve is concave or convex. And, depending on the distance of the object from the lens (as well as such phenomena as focal points, refractive indices, and the like), the image presented to the eye may be upside down and smaller than the object, or right side

up and larger; the image may disappear entirely, or it may be virtual, that is, only apparently real. Mirrors, too, can be concave or convex so that images are distorted; with plane mirrors, images are virtual, that is, behind the mirror.[15] In the case of the eye, the image is righted in the brain. Also, the eye can accomodate itself to the distance of the object, although the image may be distorted by an imperfect curvature of the lens; these conditions of distorted images are correctible by concave and convex lenses.[16]

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[15] D. A. Keys, et al., pp.88-102.

[16] One reason for the importance of the sense of sight and its distortions in Ulysses is obvious: Joyce suffered all his life from poor eyesight and severe eye ailments. Another is simply that the act of measurement, the foundation of experimental science, is an optical act, and much less a tactile one. (Sir James Jeans, p.11). That is, we know space largely through our eyes. In Circe, Stephen, without glasses, ("Broke them yesterday. Sixteen years ago.") says, "Distance: The eye sees all flat. Brain thinks. Near: far." (666). The "ineluctable modality of the visible" is space. Marshall McLuhan's thesis in The Gutenburg Galaxy (New York: Mentor Books, 1969) is conerned with the effects of printing which, he says, changed western culture from and "audile-tactile" one to a visual one. The sense of sight is also important to Stephen's concept of epiphany. According to his theory, a blind person could not have an epiphany because the epiphany is supposed to occur in the object or in the relation between mind and thing, not in the mind alone. In Wandering Rocks and in Sirens, Bloom wonders what the Blind Strippling "sees" as he taps his way around Dublin.

Sight, in the physical sense, can be enlarged to include broader and broader fields of vision through the aid of other technologies. Just as eyeglasses can aid in gaining accurate sight, the telescope extends human vision to the galaxies. Herschel's telescopic observations of the stars in the milky way, for example, led to the discovery that rather than the formation's being an area more concentrated with stars than are other areas, it was actually an "uncondensed milky way" (819); that is, accurate information is largely, if not entirely, a matter of more accurate eyesight. The microscope extends vision in the other extreme to, for example, "the universe of human serum constellated with red and white bodies" (820).[17] The camera ensures permanence of the products of eyesight in the state of flux. This technology also interests Bloom: he carries a photograph of Molly in his pocket, perhaps as a visual mnemotechnic, in case he forgets what she looks, or looked, like.

The "actual" location of an object, that is, its distance from the point of observation, can be verified through the method of parallax. This involves measuring the amount that an object seems to be displaced against

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[17] Time measurement, although made into a visual act in Newtonian physics, was later thought to be something not amenable to infinite division. This is Bergson's argument; it is part of the argument of any romantic or mystical evolutionary theory.

a fixed background that is used as a frame of reference. The farther away the object, the smaller the amount of displacement.[18] The effect can be illustrated by holding one finger out at arm's length and siting it first with one eye, then the other. The shift of the finger against the background objects is the parallax. But the eye is not good for objects more than a few feet away because, for distant objects, displacements are immeasurably small. As a consequence, the eyes would have to be farther apart to increase the angle of displacement; in astronomy, this is done by taking sitings from two distant positions by photography. Astronomically, parallax is an apparent shift in the position of a star in the sky caused by a change in the location of its observer. If, for example, a relatively nearby star is photographed from earth in June and again in December—when the earth will have travelled halfway around the sun—its position against more distant background stars will appear to have shifted. In the above example, one eye represents the earth's position in June, the other in December; the shift is the parallax. Furthermore, there are two kinds of parallax in astronomy, diurnal and annual, when the

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[18] This was the reason that Copernicus, to counter the objection that the fixed stars showed no annual parallax to the unaided eye, moved the stars far enough out so that a parallax would be unobservable. He thereby increased the extent of the universe, the first step in its becoming theoretically infinite. (See Chapter I, p.26).

celestial object is observed from opposite points of the earth's orbit. Because the correct position of the star is that which it would have if viewed from the earth's center ("discernible by daylight by an observer placed at the lower end of a cylindrical shaft 5000 feet deep sunk from the surface towards the centre of the earth", 819) or from the center of its orbit, the parallax is actually calculated and stated from these central points and is called geocentric and heliocentric respectively.[19]

In this way, parallax connects the objects of vision of the self, the self and others, and the simultaneous observations by two people of the same object. Parallax, therefore, functions as a connecting device between individual and world, between individuals, between individual and community. It extends from one person's range of unaided natural vision of several feet to the communion of two people's vision in determining the location of objects at the ranges of the distant stars, impossible in a single instance to obtain alone. Bloom's imaginary trip "to the extreme limit of his cometary orbit, beyond the fixed stars and variable suns and telescopic planets . . . to the extreme boundary of space" and his return "as an estranged

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[19]George Gamow, One Two Three . . . Infinity: Facts and Speculations of Science (New York: Bantam Books, 1967), p.275; Timothy Ferris, The Red Limit: The Search for the Edge of the Universe (New York: William Morrow and Co., 1977), p.259.

avenger, a wreaker of justice on malefactors, a dark crusader, a sleeper awakened" (858) indicates the vastness of this modern Ulysses' orbit in comparison to that of his predecessor. But because the trip is imaginary, it ironically demonstrates Bloom's impotence in attempting to encompass the entire universe and indicates, therefore, an important distinction between him and his prototype and between their respective worlds: for the original Ulysses, it had been possible to travel throughout the known world; for Bloom, it is not, except in imagination, and even this he knows to be irrational.

The phenomenon of parallax, presented ironically, is the form through which not only accurate locations or perceptions but also a unity of vision are supposed to be gained. But Stephen and Bloom, although they simultaneously[20] see a comet streaking across the sky, certainly hear

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[20]The notion of "simultaneity" recalls Leibniz's opposition to Newton's absolute time (Chapter I, pp.56-58), and foreshadows Einstein's Special Theory of Relativity. Einstein noticed that all time measurement depends upon the idea of simultaneity, that is, the coincidence in time of an event with, for example, a particular position of the hands of a clock. But although this is true for nearby events, it does not hold for very distant events which depend upon the relative position of the distant event and upon the mode of the observer's perception of it. If both the distance of the event and the velocity of the signal that connects it to the observer are known, then he can calculate the time at which the event occurred and can correlate this with some previous instant in his own experience. This calculation will be unique to each observer. Newtonian time assumed that the time of an event determines

vastly different things in the chimes of St. George's, the one the prayer for the dying he has thought of earlier in the day, "Liliata rutilantium. Turma circumdet. Iubilantium te virginum. Chorus excipiat", in keeping with his sacramental view of existence, the other "Heigho, heigho. Heigho, heigho" (826-7), in keeping with his more prosaic existence. This demonstrates both the circularity of Ulysses and the essentially unresolved nature of their "communion".

As they gaze at the "visible luminous sign . . . the mystery of an invisible person, denoted by a visible splendid sign" (824, Molly, the third person of the holy trinity) while they urinate, Stephen thinks of St. Catherine and of the "sacerdotal integrity of Jesus circumcised" (825), Bloom of the condition of his penis. That they see "signs" or "symbols" indicates that although these may point to the "thing-in-itself", they are not the real thing, that it is possible either to notice these signs or not (Stephen does not notice until Bloom points it out), and that it is likely that what, if anything, lies behind them is amenable

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the time of perception, and that all perceived events could be brought into a single objective time which is the same for all observers. Einstein showed why the hypothesis that all observers must assign the same time to a given event should be rejected (Whitrow, pp.89-90; Bernstein, pp.55-59). Needless to say, this foreshadowing throws into doubt not only what Stephen and Bloom see when they look at the comet but also even if they see the same event at the same time. Neither comments upon the passing comet.

to misinterpretation or at least to different interpretation. The comet they see can only indicate a wish or hope.

If it were possible to attain a unified view, then this parallax should have been dissolved into a single vision. In the Circe episode, the only dissolution of parallax possible was through hallucination. We are told in the stage directions that when Stephen and Bloom peer into the mirror, they see the face of Shakespeare, cuckolded, usurped; Bloom's only response is "When will I hear the joke?"; Stephen says and does nothing. When the image in the mirror changes into Martin Cunningham, Bloom has nothing to say; Stephen comments upon lust and lasciviousness. Thus, while it may be possible to have a mystical experience (or hallucination), it is not possible to gain verifiable knowledge of the world from it; one cannot know whether another viewpoint is more correct, incorrect, or even occurring. The experience is certainly incommunicable and non-communal. In the Ithaca episode, the problem is introduced in order to determine whether it is possible to gain real knowledge about the world by proceeding from the rational to the irrational, from the known to the unknown, that is, to determine whether or not the syllogistic procedure is valid. Bloom concludes that it is not. The other way, of course, is Bloom's scientific method: he goes from the unknown to the known, inductively, through the incertitude

of the void, and we have seen where this has gotten him. Both methods, the Aristotelian syllogism and the neo-Platonic dialectic, are nullified, the former because it seems to operate on nothing (across the void), the latter because it requires a mystical leap of faith (from the void). The syllogism excludes the irrational, all the things which bother Stephen; the dialectical method, for practical purposes, is impossible because it requires a faith which it is no longer possible to sustain, and because it provides only mystical, non-communicable, unverifiable knowledge.

Because the security of a stable world view is no longer attainable, in Joyce's portrayal the modern man turns towards technology and economics which he then invests with a belief equivalent to what had earlier been given religion, but not equivalent to what has been lost. In Ithaca, Bloom's acquisitiveness is depicted as an alternative to what he cannot have--the emotional security of a stable philosophical and theological world in which knowledge and faith are unquestioned.[21]

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[21]Clearly, Bloom is much more than "Mr. Average"; were he not, irony on such as large scale would not be possible. It would not have been difficult for Joyce to have portrayed a mere bumbler steeped in technology, and taking his faith therefrom. Without Bloom's sympathetic kindness and his practical ethics of love, comedy could not occur. It is the sensibility of the questioner that is parodied; Bloom is the subject of a much larger cosmic irony.

Moreover, this attitude was not restricted to "mass men", to the worshippers of the control attainable in the marketplace through the idol technology. Nor were they the only ones under the influence of both the fatigued world view and its alternative, technological immanence. Even the literature and art of the period, and not only the mass-produced reproductions and rhymes, have been characterized as a type of technology or "conquest by method", the greatest achievement of the 19th century having been the discovery of method itself through whose application anything could be discovered.[22] As the scientific method, a technique for gaining only limited knowledge of the world, was applied to increasingly more areas of human endeavour, it tended to encompass even poetry in its technological mentality. The result of technology, or methodology, in this sense could equally well have been a turbine or a symbolist poem.[23]

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[22]Sypher, Literature and Technology, p.10. Sypher gives a good example of the technological mentality in Fred W. Taylor's attempt to train, through the method, a workman to shovel 47 tons a day rather than 12. After reckoning the weight of the shovel, its size, its bite, the arc of the swing, the number of steps and other motions, Taylor considered that he had eliminated all useless (non-profitable) effort and ensured the employer "maximum prosperity". This is the mentality of the questioner-persona in Ithaca, who would attempt to eliminate any accidents and all chance, if he could.

[23]Sypher's distinction between science and technology on the basis of their different motives, "pure" disinterested knowledge or control, is therefore a false dis-

The pervasiveness of technology in all spheres of life goes hand in hand with economics (for Bloom this means money and property, a new social status), in both of which he puts whatever faith he has left in the possibility of improving his life. His schemes are unlikely ever to be fruitful as his beliefs-of-a-lifetime, his scientific "metaphysics", are systematically undermined through the episode. Thus, although the scientific method, in the form of technology and inventions, had expanded its sphere of influence, the possibility for attaining success and riches in this way was an option open to few; underlying this "get rich quick" optimism was a pessimism concerning the disintegration of a world based equally on this science. Insofar as Bloom is representative of the modern psyche, he reflects both the optimism and the pessimism. His dejection and loneliness, which he ascribes to indigestion and to his wife's unfaithfulness, he, as "physicist, philosopher, and physiologist", does not really understand. All he can do is to will himself out of those areas that cause him anxiety:

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tinction: technology stems from science, and sometimes the other way round; they were interdependent long before 1904. Thus, the principles Bloom can't remember and the inventions he dreams of creating for the purpose of attaining security, financial or otherwise, are intimately related through the method common to both. That Bloom's talents lie in the direction of the applied version simply demonstrates the futility of his ambition in that he is without the principles that he wants to apply. Stephen, who intends to apply his talents to the crafting of poems, is a more fortunate technologist in that he has the ability to learn or create his method. In any case, one cannot ascribe motives to techniques, only to those who use them.

he exercises, watches his diet, and, in general, cultivates his body in the hope that the proper functioning of that machine will help keep his emotions steady. His mind he exercises with mnemotechnic; with schemes "difficult of realization" and Proustian recollections of the past, he hopes to sleep well. His dream of acquiring a house and property to which he can apply his technical know-how towards effecting the latest improvements, in short, his desire to become part of the landed gentry, is unlikely ever to occur: it depends on random chance, on luck, on deceit, and is as likely to happen as the marked coin's returning to him. It is certainly nothing he can count on.

His plans for social reform, seemingly realizable once, have been brought to nought. He has believed in the printed word, in the power of literature to instruct, and in the efficacy of education, having applied himself to the works of William Shakespeare for the "solution of difficult problems in imaginary or real life," (791), but has found that these texts do not provide answers to all questions, nor complete answers to those they do deal with. His attempts to educate Molly (802-04) have been futile because, in her ignorance, she employs false analogy, that is, relies on superstition and intuition; Milly has simply learned to please him; his attempt to gain instruction from Stephen is also futile. The kind of information to be gained from print is reduced to what can be seen at a

glance, information that is used for selling and that may, therefore, be false—the ad. His only recourse is to dream of improving the educational scheme of kindergarten, of the next generation, but not of his progeny, through inventions designed to teach a scientific world picture. Because he seems to have resigned himself as far as his own family is concerned to their hopelessness and to his inability to change the cause and course of their lives, he designs imaginary schemes for society. But by the end of the episode, he is no longer convinced that human nature can be socially and morally redeemed at all; rather, he thinks that it will probably "remain inalterably and inalienably attached to vanities, to vanities of vanities and all that is vanity." (821).

This moral and social aspect of education, upon which the entire Enlightenment notion of progress and perfectability was dependent, is stressed in Ithaca: if education is not efficacious, then humankind cannot be improved by reason alone, and may be fundamentally irrational. Bloom himself is afraid of suffering an "aberration of the light of reason", and when his thoughts enter pathways he cannot handle, his only recourse is to will or to physical escape. Furthermore, if the fundamental premises of education are unsound, then the credibility of the rest of the system is undermined. The clockwork cosmos and its

extension into other areas of human existence may be a false analogy. The only causality may be that determined by the throw of dice. Science may have turned from progress and evolution to entropy and the degeneration of man.

Underlying the official philosophy of the Enlightenment were assumptions based upon both human and natural law; about these, Bloom has something to say. He cannot believe in the perfectability of human life even were poor social conditions, "the product of inequality and avarice and international animosity", eliminated because natural law does not take into account killing for the purpose of feeding, the pain of separation, birth, and death, accidents, insanity and criminality, catastrophic cataclysms, and "vital growth, through convulsions of metamorphoses from infancy through maturity to decay." (817). That is, both human and natural law fails to account for the possibility that man, the universe, and God may be fundamentally evil or irrational. In the Circe episode, this problem is presented in relation to the trinity and its transformations in the Black Mass. In the sex transformations, no androgynous being is created; instead, Bloom, transformed into a female, has to submit to Bello's "heel discipline". Women's reason, intuition, is associated with the sinister.

In Ithaca, both the deity, if it exists, and nature, if it can be known, are seen only through "signs" which are

both feminine and evil. This is depicted in Bloom's scientific meditations. The geological and biological, that is, evolutionary sciences have undermined both the mechanical and romantic primitivist views of nature and man, making optimistic human and natural law unsatisfactory explanations, but the inversion has brought evil to the forefront of explanation.

Thus, when Stephen and Bloom proceed from the "house of bondage" to the accompaniment of the 113th psalm and see the "heaventree of stars hung with humid nightblue fruit", all indications are that the religious and scientific explanations are being tested together, and that if one goes, so too does the other. The first meditation is on astronomy:

> Meditations of evolution increasingly vaster: of the moon invisible in incipient lunation, approaching perigee: of the infinite lattiginous scintillating uncondensed milky way, discernible by daylight by an observer placed at the lower end of a cylindrical vertical shaft 5000 ft deep sunk from the surface towards the centre of the earth: of Sirius (alpha in Canis Major) 10 lightyears (57,000,000,000,000 miles) distant and in volume 900 times the dimension of our planet: of Arcturus: of the precession of equinoxes: of Orion with belt and sextuple sun theta and nebula in which 100 of our solar systems could be contained: of moribund and nascent new stars such as Nova in 1901: of our system plunging towards the constellation of Hercules: of the parallax or parallactic drift of socalled fixed stars, in reality ever moving from immeasurably remote eons to infinitely remote futures in comparison with which the years, threescore and ten, of allotted human life formed a parenthesis of infinitesimal brevity. (819)

The meditation is based upon the "evolution" of stars and planets to infinity in space: from the closest heavenly body, the moon, through our galaxy, the milky way, discernible by geocentric parallax, to the stars, visible only by telescope technology, in other words, the macrocosm extended to the void infinity. However, with the largest of the stars, Arcturus, the meditation begins to change: the remainder is concerned with an evolutionary, not a fixed, solar system in which stars are born and die. It ends with infinities of time in comparison with which a human life span is nothing. In the second meditation, the insignificance of a single individual over the entire course of the earth's evolution is the subject:

> Of the eons of geological periods recorded in the stratifications of the earth: of the myriad minute entomological organic existences concealed in cavities of the earth, beneath removable stones, in hives and mounds, of microbes, germs, bacteria, bacilli, spermatozoa: of the incalculable trillions of billions of millions of imperceptible molecules contained by cohesion of molecular affinity in a single pinhead: of the universe of human serum constellated with red and white bodies, themselves universes of void space constellated with other bodies, each, in continuity, its universe of divisible component bodies of which each was again divisible in divisions of redivisible component bodies, dividends and divisors ever diminishing without actual division till, if the progress were carried far enough, nought nowhere was never reached. (819-20)

Beginning with time, this second meditation proceeds through numbers of increasingly smaller creatures; that is, it changes from time to space until this microcosm bends

back upon the macrocosm in a circle. The problem of continuity and divisibility is carried on until "nought (nothing, zero) nowhere (no space) was never (no time) reached". But because infinity is a mathematically abstract and physically unreal concept, the result of this division of real physical bodies cannot be accomplished to infinity because there is always something left over. The meditations, therefore, are an instance of Zeno's paradox.[24] The infinite abstract heavens cannot be united with the finite physical earth, or, put another way, the squaring of the circle is impossible.

Ironically, Bloom feels insignificant in the "scheme of things" as the result of technology, which provided the physical means of extending sight, through the "macroscope" and microscope, closer to infinity, or nothingness; the parody lies in his hope of ever being able to "see" infinity through physical means, and in the paradoxical epistemology that is the result. Thus, for Bloom, the history of science from the quadrivium to modern science has been his reduction "by cross multiplication of reverses of fortune . . . and by elimination of all positive values to a negligible negative irrational unreal quantity." (855)

This, and the solution to the circle of the two meditations, is approached mathematically in the meditation on

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[24] See Chapter I, p.41, fn.40.

Pi. Bloom is unable to elaborate his calculations to a more precise result

> Because some years previously in 1886 when occupied with the problem of the quadrature of the circle he had learned of the existence of a number computed to a relative degree of accuracy to be of such magnitude and of so many places, e.g., the 9th power of 9, that, the result having been obtained, 33 closely printed volumes of 1000 pages each of innumerable quires and reams of India paper would have to be requisitioned in order to contain the complete tale of its printed integers of units, tens, hundreds, thousands, tens of thousands, hundreds of thousands, millions, tens of millions, hundreds of millions, billions, the nucleus of the nebula of every digit of every series containing succinctly the potentiality of being raised to its utmost kinetic elaboration of any power of any of its powers. (820)

The major difficulty in the way of a solution to the problem of squaring the circle both secularly (arithmetically) and mystically (through the geometrical construction of the New Jerusalem in Circe) is the number Pi, 3.1716..., an irrational and transcendental number. The conclusion is, therefore, that the solution to the problem represented by the quadrature of the circle and by these meditations can only be both approximate and mystical. That this difficulty is meant to be extended to human life is indicated in the answer to the question concerning the possible moral and social redemption of a species on another planet: the problem is only of a different order of difficulty (821); there as here, the problem seems hopeless of solution. "The minor case is proved by the major" encompasses this answer musically.

Thus, the rational quadrivial arts (arithmetic, geometry, music, and astronomy) produce only an irrational, transcendental, non-epistemological solution, a solution which, to Bloom, can be none. He can, therefore; only conclude that what he sees is "not a heaventree, not a heavengrot, not a heavenbeast, not a heavenman. That it was a Utopia, there being no known method from the known to the unknown." (823). All of it he ascribes to false analogy and is, consequently, left with no means to extend knowledge. Everything is superstition, and he, like Moses when the lights were out, is "in the dark". To this profound pessimism is added the final blow—one cannot know God. One can only believe in an ironic sign of her presence by using female logic, intuition. In the end, this belief is only superstition, a belief that the "thing-in-itself" is a hymen, the only consolation a woman's buttocks. Behind the veil of Maya, in the shadows and forever unknowable, lies an evil female deity.

The Ithaca episode turns around at Stephen's departure as the Circe episode does at the Black Mass. Because this section contains a great deal of mirror imagery, we know we are back to the parallax conditions in which no unity of vision is possible. The books are inverted, Martha Clifford's name is written in "reversed alphabetic boustrophedontic puntuated quadrilinear cryptogram (vowels suppressed)", Bloom's image is asymmetrical. All the imagery is

of doubleness, coldness, and death. Bloom, weary and alone, has difficulty getting back to the "describe them" state of mind. But as he relieves his discomfort by undressing, he tries to account for the day's expenditures, and exercises his mind by ruminating about property.

However, even though all his material ambitions have coalesced into the dream of owning property, he knows that the only way he can acquire the money to pay for such a project is through deviousness (by the use of telegraph technology to obtain the results of a horserace before the betting wickets close), or through luck (in the chance discovery of a precious stone, a donation, a contract to be paid for in geometrical progression to 32 terms). Thus, even this meditation functions around an empty hope. It is exactly what he says it is—a mental exercise by which he can artificially placate "malignant agencies chiefly operative during somnolence", that is, his unconscious in which he fears are desires to commit homicide or suicide.

The contents of the dresser indicate the backwards movement of this section of the episode. The cryptogram indicates not only parallax perception but also the reduction of identity to numerology; the rectal medicine shows that even sex is backwards; the attestation of name by deed poll shows a covert identity. His father's suicide note evokes bad memories for Bloom because he is beginning

to forget; for this, and for not having honored the old man's beliefs, he feels guilt. He now sees those beliefs as not any less rational than other, scientific, beliefs now appear. His father's legends and myths are fading from memory. His meager consolation is the endowment policy, the bank passbook, the certificate of the possession of scrip (855). These are all that stand between him and what he most fears: poverty, mendicancy, destitution, and the "nadir of misery: the aged impotent disenfranchised rate-supported moribund lunatic pauper." (855).

His fantasy of exile, as Everyman and Noman, to the stars, and his return, by metempsychosis, as a dark crusader, to wreak justice by bringing on the Apocalypse whereby the old world will come to a fiery end and a new one begin, he sees as irrational, impossible because time cannot be reversed. Inertia, continuing on the same course unless a miracle intervenes, and narcissism, "desired desire", make it more likely that he will sink further into solipsism and impotence. As he goes to bed, he imagines the vanity of thinking oneself either the first (God) or last (Apocalyptic avenger) term in any series when he is "neither first nor last, nor only nor alone in a series originating in and repeated to infinity." (863). He has been cuckolded, he will be cuckolded, and he will resign himself to the altered conditions of his existence because he sees his usurpation and its consequences as "more than

inevitable, and irreparable." (865).

He puts on his nightshirt and enters (with circumspection, with solicitude, prudently, lightly, reverently) the bed of "snakespiral springs, brass quoits and pendant viper radii", as though into a "lair or ambush of lust or adder" (862); there, in the "bed of conception and of birth, of consummation of marriage and breach of marriage, of sleep and of death" (862), lies his unfaithful Molly/Penelope/Eve. His thoughts of Boylan cause "envy, jealousy, abnegation, equanimity" (864), but he decides that Molly's adultery is "not as calamitous as a cataclysmic annihilation of the planet in consequence of a collision with a dark sun", as less reprehensible than theft or wilful and premeditated murder (865) so that any possible retribution he, justified by the "apathy of the stars", decides to leave for some later, unspecified date (866). Thus, the old order has been usurped, ineluctably. But the new one cannot be the issue of Boylan and Molly, of Satan and the fallen Eve, because the Christian myth is dead. (Next morning she menstruates.)

However, there are some things he omits telling Molly about his own activities: the correspondence between Martha Clifford and Henry Flower, the brawl in the pub, Gerty McDowell. He does tell her of a performance of Leah, leaving her to assume that the performance, not the

brothel, is where he has spent the evening, of a book of pornography, of rescuing Stephen Dedalus, professor and author, from a false move in a gymnastics display. Molly's concern is that she and Bloom haven't had "physical intercourse" since Rudy's death, Bloom's that they haven't had "mental intercourse" since Milly began to menstruate. The result of Milly's move into adulthood has been a feminine conspiracy "in consequence of a pre-established natural comprehension in incomprehension" to quiz Bloom on his whereabouts in the (incorrect) suspicion that his real interests are turning elsewhere. Whether the new order is to be Bloom's and Molly's issue depends, first, on their resolving this lack of physical and mental intercourse and, second, on their ability to produce a living male heir. The prospects for this do not look promising; perhaps the "feminine conspiracy" will be their only offspring as each continues to travel along on their separate "world lines".

As the narrator's camera-eye moves up towards the heaven's, we see them carried "forward and rereward respectively by the proper perpetual motion of the earth through everchanging tracks of neverchanging space" (870), she, Gea-Tellus, Mother Earth, "big with seed", upon whom new worlds and myths will be created, he, the "childman weary, the manchild in the womb", Ulysses, who now retreats into his (our) dream as a voyager of the east, Sinbad—

back through the alphabet to when there was "a square round Sinbad the Sailor roc's auk's egg in the night of the bed of all the auks of the rocs of Darkinbad the Brightdayler" to . . . the beginning, to the east where rise not only the sun but also new gods, the new heaven and new earth.

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