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Uniformity and Diversity of Nature in 17th Century Treatises on Plurality of Worlds

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UNIFORMITY AND DIVERSITY OF NATURE IN 17th CENTURY TREATISES ON PLURALITY OF WORLDS

Armchair, *a priori*, science has its attractions, for its pursuit does not involve the tedium, and perhaps even social stigma, of travail in the laboratory. But this kind of science has its difficulties too. The discoveries made thereby often turn out to be purely linguistic; and unanimity as to the axioms and the manner of their application seems impossible to achieve. [1] In the ordinary affairs of physics and chemistry the advantage has lain with the sooty empirics, who have based their hypotheses on experiment and observation, or at least tested them thereby; intrusions of *a priori* assumptions have tended here to play a relatively minor role, at least in the presentation of theory. But there are some fields which are inaccessible to observation, where if there is to be science at all, it must perforce be of the *a priori* kind. Probably the most popular of these from the seventeenth century onwards has been the plurality of worlds. Into this boderline territory between scientific knowledge and science fiction, a region which is only now beginning to be actually explored, a number of important figures in seventeenth century science boldly intruded, with analogy their only guide. The study of the works they wrote is both entertaining in itself, and may also cast light on the assumptions they made elsewhere; for in discussions of plurality of worlds the metaphysics is often explicit, which in more formal treatises is suppressed.

There were various forms of this literature, some more genuinely concerned with the physical conditions of the various heavenly bodies than others. Cyrano de Bergerac, for example, [2] intended satire on Earth-dwellers rather than description of the countries on the Sun and

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[1] For a discussion of this, see R. Harré, *The Anticipation of Nature*, London 1965.

[2] Cyrano de Bergerac, *Other Worlds*, trans. Geoffrey Strachan, London 1965.

Moon. In Antiquity this kind of tale was written by Lucian in his *Icaromenippus* and *True History;* such works are precursors of Jonathan Swift's, and perhaps of modern science fiction, but do not really tell us any more about speculative astronomy than *Gulliver's Travels* tell us about geography. So we shall not be further concerned with them, but with those who would have considered that they were doing work of scientific value.

Plutarch had presented arguments[3] in favour of the Moon being another earth: "as an earth she seems perfectly beautiful, noble, and well ordered thing, but as a star or luminary or a divine and heavenly body, I fear she will prove unshapely and uncomely, and will do no credit to her beautiful name." Shining only by borrowed light the Moon gives us no heat; and like the Earth, she has great mountains, and depressions containing water or dark air, which, not being lit up by the Sun, appear dark and give rise to her apparent face; the subject of the book. We should not suppose, in judging her a celestial earth, that she is: "a body without soul and intelligence, and without part in the things of which it is meet to offer the first fruits to the gods..."; that is, she does not lack what seventeenth-century authors were to call "dress and furniture."

The conjectures of Plutarch were supported by the telescopic researches of Galileo;[4] who was able, from the shadows they cast, to estimate the height of the lunar mountains. The telescope, if one accepted what was seen through it as evidence, revealed that the Moon was indeed another earth rather than a perfect sphere of quintessence; and also that Jupiter was encircled by moons, indicating an analogy between that planet and ours. Galileo was himself reluctant to speculate on whether there might be men on the Moon, a notion which would have had theological dangers since all men were declared to be descendents of Adam and Eve, and no record existed of any emigration to the Moon. But Kepler in his *Dream,*[5] a book which circulated for a long time in manuscript, had already in 1609 described a "visit" to the Moon, and the creatures to be found there. Lunar voyagers were drugged, and whisked thither during an eclipse by daemons invoked by suitable incantations. Kepler put seas on the Moon, and deep caverns to afford shelter from the extreme inclemencies of the climate. He spoke of the "people" on the Moon; but his main object was not to

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[3] In T. Heath, *Greek Astronomy,* London 1932, pp. 166—180. The quotations are from pp. 176 and 178.

[4] See S. Drake; *Discoveries and Opinions of Galileo,* New York 1957, pp. 21—58. And J. Kepler, *Conversation with Galileo's Sidereal Messenger,* trans. E. Rosen, New York—London 1965, p. 27.

[5] J. Lear (ed.), *Kepler's Dream,* Berkeley—Los Angeles 1965. Kepler appended Plutarch's Face *in the Moon* to this work; and had read Lucian. See also M. Nicholson, *Science and Imagination,* Ithaca, N. Y. 1956, III.

describe these inhabitants, but to argue for the motion of the Earth by showing that Moon-dwellers (would like) us think of themselves as being at rest, while all the heavenly bodies circulated around them, and the Earth rotated before their eyes.

In an appendix, written later, Kepler applied the doctrine of uniformity of nature with some determination, arguing that geological processes analogous to those happening on Earth must sculpt the lunar surface. But the round cavities there seemed artificial, the result of "architectural intellect;" and it was therefore necessary to conlude that there were rational creatures who had built them.[6] These inhabitants must be very numerous in order to have built such constructions, which resemble, but surpass, in scale the Pyramids and the Great Wall of China. Kepler suggested that since the lunar climate was more extreme, and its landscape more rugged, than those we encounter, the inhabitants would probably be bigger and hardier than we. The round patches that they had so laboriously constructed could be nothing but fortifications against enemy assault.

Kepler's speculations about the Moon were at least based to some extent on empirical observations. The Moon after all could be inspected, and gross details on its surface descried, through telescopes. The solar planets, and their satellites, could also be seen, although very few details could be discerned; so those who would put living creatures on these heavenly bodies needed to take little note of empirical evidence in their imaginings. The next step was to postulate inhabitants for the hypothetical planets circling the fived stars; bodies whose existence remains unconfirmed to this day. Naturally in this field the way lay open to the most unguarded speculation; for almost any properties could be proposed for the hypothetical inhabitants of hypothetical worlds. We should be surprised therefore at the relative unanimity of writers on the subject rather than at their divergences.

In Antiquity, the doctrine of plurality of worlds was held by the Atomists, who, since they postulated an infinite number of atoms in an infinite void, believed there must be innumerable worlds coming into being and passing away at any given moment. All these worlds would be different;[7] according to Democritus: "there are innumerable worlds, which differ in size. In some worlds there is no sun and moon, in others they are larger than in our world, and in others more numerous." The spacing of worlds is irregular also; and some are devoid of plants, moisture, or living creatures. The physicists of the seventeenth century, being more teleologically minded, accepted the thesis that

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[6] *Kepler's Dream.* p. 173; Kepler, op. cit., p. 28.

[7] G. S. Kirk, J. E. Raven, *The Presocratic Philosophers*, Cambridge 1957, p. 411.

there was a plurality of worlds, but denied the infinite diversity of nature. Another half-way position is found in Plutarch's *Why the Oracles Cease to Give Answers,* where the suggestion is made[8] that though belief in an infinite number of worlds arising by chance is incompatible with belief in God, the existence of several is very probable. Five was a likely number, since there were five Platonic solids; a speculation reminiscent of Kepler's theory that the interplanetary distances could be accounted for in terms of a nest of these solids, centred on the Sun.

Those who wrote on plurality of worlds with whom we shall be most concerned here are Wilkins, perhaps the leading figure in the foundation of the Royal Society; Fontenelle, who became Perpetual Secretary of the French Academy of Sciences; and Huygens, one of the outstanding scientists of the day, best known for his work on clocks, his astronomical discoveries, and his wave theory of light. Speculations such as theirs naturally gained plausibility from Copernican astronomy, in which the Earth was one planet among many rather than the centre of the Universe; but in fact pre-Copernicans, applying the principle of plenitude,[9] had concluded that if to create one world were good, to create several would be better; and that God would therefore have done so. Wilkins, who despite his marriage to Cromwell's sister became a bishop after the Restoration of Charles II, was concerned in his book[10] chiefly to make the world safe for Copernicans and speculators on plurality of worlds. Following the Baconian programme of confining theologians to theology, he showed at lenght what absurdities were generated when the statements of the Fathers, and some passages of the Bible, were taken seriously as physics. "Truths" he noted, "have been formerly esteemed ridiculous, and great absurdities entertained by common consent." Aquinas had argued that other worlds must be the same or different; if the same, then why should have God made them; and if different, then both cannot contain universal perfection, so neither can separately be a true world or universe. Wilkins turns this by not using "world" in this sense, but to mean "earth"; and his successors did the same.[11]

The fact that the Bible did not mention other worlds did not make any difference on Wilkins' view, for the negative authority of Scripture is not "prevalent" in matters not fundamental to religion; besides,

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[8] A. H. Clough, W. W. Goodwin, *Plutarch's Lives and Writings,* 10 vols., London, n. d., IX, pp. 29—39.

[9] A. O. Lovejoy, *The Great Chain of Being,* New York 1960, p. 115.

[10] (J. Wilkins), *The First Book. The Discovery of a New World or, a Discourse tending to prove, that 'tis probable there may be another habitable World in the Moone. With a discourse concerning the possibility of a Passage thither.* 3rd imp., London 1640.

[11] *Ibid.,* p. 1.

the solar planets are not even mentioned in the *Book of Genesis* as being created. In general, Wilkins declared,[12] "...absurdities have followed, when men looke for the grounds of Philosophy [Science] in the words of Scripture." It would be more economical of Divine Wisdom, given a body such as the Moon, to use it both as a moon and a world, than in only one capacity. The spots and bright parts on the Moon seem a deformity; but if it is a world, then they will be seas and land; and lunar soil is probably very like terrestrial. In its eclipsing of stars the Moon seems to give some evidence that it has an atmosphere, or "orbe of grosse vaporouse air," and this is supported from analogy, for the sun also seems to have one. Probably the "meteors" on the Moon—its weather—would be like ours. Plutarch had thought such things might be very different, because of the variety of ways Nature uses to bring about similar effects; but Wilkins argued that the close parallels between the Earth and the Moon revealed by the telescope indicated a general similarity.

In the same way, the extent of positive analogies between the Earth and the other solar planets made it likely that all were worlds. In particular, Saturn and Jupiter had moons; and Wilkins concluded that: "if you consider their quantity, their opacity or these other discoveries, you shall find it probable enough, that each of them may be a severall world."[13] As to their inhabitants, it is clear that Providence has so furnished the Moon with conveniences that there must be somebody to enjoy them. Probably not men,[14] "but some other kind of creatures, which beare some proportion, and likenesse to our natures." On the other hand, they might be quite different, for God might have glorified himself in the creation of an infinite diversity of creatures. Planetary creatures might be midway between men and angels. Wilkins sanguinely expected that posterity would get to the Moon to converse with its inhabitants, using some kind of flying chariot to escape from the Earth's gravitational force, which in Wilkins' view extended only twenty miles from the surface.

In a later book he tried to deal with the teleological or quasi-aesthetic argument that the fixed stars were, on Copernicus' hypothesis, unnecessarily far away. His solution was that there were rational creatures nearer these luminaries than we are: "our disabilitie to comprehend all those ends which might be aimed at in the works of nature, can bee no sufficient Argument to prove their superfluitie. Though Scripture doe tell us that these things were made for our use, yet it do's not tell us, that this is their only end. 'Tis not impossible,

[12] *Ibid.*, pp. 29, 37. See also G. McColley, "The Seventeenth Century Doctrine of a Plurality of Worlds," *Annals of Science*, I, 1936, pp. 385—430.
[13] *Ibid.*, p. 180.
[14] *Ibid.*, p. 190.

but that there may be elsewhere some other inhabitants, by whom these lesser stars may be more plainly discerned." [15]

In Wilkins' works the lines are laid down along which Fontenelle and Huygens were to proceed; but whereas in the 1640s it was still necessary to defend the Copernican system, by the 1680s this theory had become the accepted one. The authority of the literally intepreted words of *Scripture* or the Fathers was no longer, at least in astronomy, what it had been; and the only theologically dangerous area was speculation on the inhabitants fo the celestial worlds.

Wilkins had included the cavet that while the inhabitants of the Moon and the solar planets were probably very similar to those of the Earth, they might be extremely, or even unimaginably, different. But if they were supposed altogether dissimilar, his whole argument would collapse, since he was arguing from the observed similarity between the Earth and the Moon to a likeness in unobserved characteristics. No such observations and analogical reasonings could reveal anything about unimaginable entities. The argument that other planets might merely be rather similar to the Earth seems at first sight a sensible solution; but one ought in proposing this to have some idea what the difference might be. In the seventeenth century the main diversities proposed were in climate, and in appearance of the heavens at night; both these would be effects simply of the various distances of the planets from the Sun. The implication is therefore that the solar planets are all extremely similar, but differently situated. Burnet [16] added the idea that they might be at different stages of parallel geological histories. The suggestion that the rational inhabitants of other worlds might not be men was essentially verbal, advanced purely to avoid difficulties with the Churches. None of these escapes Aquinas' question, why there should be several worlds with no essential difference between them? In the nineteenth century, George Wilson did propose a possible chemical difference; there was no sufficient reason why the chemical elements should be unevenly distributed throughout the universe, and since on Earth some are rare, in other systems they must be common. [17]

Fontenelle was anxious to propagate the Cartesian system of astronomy as well as the doctrine of plurality of worlds. [18] Unlike many of his predecessors, he believed that the Moon's surface was not sui-

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[15] (J. Wilkins), *A Discourse Concerning a New Planet. Tending to prove, That 'tis probable our Earth is one of the Planets.* The second Booke, now first published, London 1640, p. 131.

[16] T. Burnet, *The Sacred Theory of the Earth*, reprinted, London—Fontwell 1965, pp. 128—9.

[17] G. Wilson, *Electricity and the Electric Telegraph, together with the Chemistry of the Stars*, new ed., London 1895, p. 29.

[18] B. le B. de Fontenelle, *Entretiens sur la Pluralité des Mondes*, ed. R. Shackleton, Oxford 1955.

table for living creatures; though he was prepared to put some below the surface. Dwellers on other heavenly bodies would not, according to his account, be men, and it would be absurd even to imagine their characteristics; but he did so—after all, this is what his readers would have been interested in—and declared that their temperaments followed their climate. Venusians were amorous, Saturnians and Jovians phlegmatic. The Sun, a self-luminous body quite unlike the Earth, was not inhabited. Fontenelle evolved an interesting twist to the argument, in that he threw onto his opponents the onus of showing why the other planets should not be inhabited.

During the seventeenth century the universe became larger, in that among astronomers belief in a sphere of fixed stars was common at the beginning of the century, while at the end the received opinion was that the Creation was infinite, or at least indefinite.[19] Derham distinguished these two notions as the "Copernican" and the "new" systems.[20] Huygens was an adherent of the new system; and using the teleological principle that everything must have been created for some purpose, and a principle of uniformity of nature, he set about peopling the cosmos.[21] He disagreed with those who installed inhabitants on the Sun and Moon, both because these seemed to be uncomfortable places and also because they had functions already; the one as a source of heat and light, the other to illuminate the Earth and cause the tides. The moons of Jupiter and the fixed stars revealed by the telescope must have some purpose; it would be absurd to claim that they were created only to be so viewed. Jupiter must be inhabited; and these distant stars must be the centres of other systems of planets.

The particular version of uniformity principle used by Huygens was based on a notion of fairness, or of sufficient reason: "Now should we allow the Planets nothing but vast Deserts, lifeless and inanimate Stocks and Stones, and deprive them of all those creatures that more plainly speak their Divine Architect, we should sink them below the Earth in Beauty and Dignity; a thing very unreasonable..."[22] The same argument established that the celestial worlds must contain rational creatures, and that they must be able to enjoy all our pleasures, and have made just as much progress in the arts of civilisation as we. If they were much smaller than we, they would have difficulty, for example, in using astronomical instruments; and God must have given

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[19] A. Koyré, *From the Closed World to the Infinite Universe*, New York 1958.
[20] W. Derham, *Astro-theology*, 10th ed., London 1767, p. XXXIV.
[21] C. Huygens, *The Celestial Worlds Discover'd: or Conjectures Concerning the Inhabitants, Plants and Productions of the Worlds in the Planets*, 2nd ed., London 1722. Similar arguments were used by the Newtonian Richard Bentley in his *Boyle Lectures*; reprinted in I. B. Cohen (ed.), *Isaac Newton's Papers and Letters on Natural Philosophy*, Cambridge 1958, pp. 356—360.
[22] C. Huygens, *op. cit.*, p. 21.

them hands, since He has not withheld these useful organs from monkeys. Every planet must have the same cycle of rain, sunshine, evaporation, though each must have: "its Waters of such a temper, as to be proportioned to its Heat." [23]

Anyone who was not an astronomer would be hard put to it to say where among these celestial worlds he was after a voyage through space; and indeed Huygens' conception of the universe borders on the tedious. His successors have narrowed the range of heavenly bodies which might be expected to be inhabited, and tend to allow, irrationally perhaps, for a little more variety; but the doctrine that other planets in the universe are inhabited by rational beings very similar to us remains as powerful as ever, especially among certain radio-astronomers, who expect to exchange signals with these folk. The teleological arguments of the seventeenth century have become less compelling; it must be the argument from sufficient reason—the *pourquoi non* of Fontenelle—which some among our contemporaries find so seductive.

[23] *Ibid.*, p. 28. For a fuller exposition of Huygens'treatise, see D. M. Knight, "Celestial Worlds Discover'd," *The Durham University Journal*, LVIII, I, 1965, 23—29.