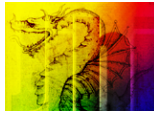


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Christiaan Huygens' *Verisimilia de
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the *Cosmotheoros*

With Its First English Translation

by

Ludovica Marinucci

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Christiaan Huygens' *Verisimilia de planetis* and its Relevance for Interpreting the *Cosmotheoros*

With Its First English Translation *

Ludovica Marinucci **

The article focuses on Verisimilia de planetis (1690), which is considered one of the main preparatory drafts of the posthumous Cosmotheoros (1698). The analysis of the most relevant examples of Huygens' intellectual vocabulary intends to show not only Huygens' reuse and hybridization of concepts and terms belonging to his wider scientific production, thus highlighting their diachronic and coherent evolution in a multilingual perspective, but also his implicit philosophical structures due to mutual exchanges with the philosophical thought of some of his contemporaries. As a result, this terminological analysis is the backbone underpinning the first English translation of Verisimilia de planetis.

1. Introduction

In 1979, during the two conferences (Taton 1982; Bos et al. 1980) that were held on the 350th anniversary of Christiaan Huygens' birth, many historians of science remarked on the incongruity of, on the one hand, the lack of critical literature and, on the other hand, the scholars' common critical judgment that Huygens' works are among the most relevant of his time. The reasons might be that the exegesis produced by the editors of the impressive 22 volumes of the *Œuvres*

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** CNR-ISTC (ludovica.marinucci@istc.cnr.it).

complètes,¹ which makes available most of the Dutch scientist's correspondence and works, had apparently explored the main research issues (Gabbey 1980), and that their rich commentary had a paralyzing effect on historians of science (Hall 1980). Furthermore, the reconstruction performed by the editors had often hidden the context and process of Huygens' discoveries, offering the image of a scientist who could easily solve a problem that seems to be clear to him from the beginning, thus ignoring the fundamental features of his researches. The emphasis on published results at the expense of the working drafts may also be a reason why most critical studies have focused on single aspects of Huygens' scientific activity, which are as various as they are specialized (Yoder 1998). It is no coincidence that the most significant studies have focused on Huygens' manuscripts kept in Leiden, showing that the National Edition is not unquestionable. On the contrary, it is likely that the formation of dogmatic interpretations of the Dutch scientist's research activity is due to the adoption of "non-neutral" editorial criteria (Mormino 2003b). Therefore, the reordering of and the comparison between each manuscript *folio* of the *Codices Hugeniorum* and its edited version in the *Œuvres Complètes* is still crucial (Yoder 2013) to shed light on Huygens' unpublished materials.

In what follows, the focus will be upon the short writing *Verisimilia de planetis*, which was dated to around 1690 and published by the editors of the *Œuvres complètes* in the volume for *Cosmologie* (OC, XXI, 542-554), grouped with three other drafts¹ relating to similar topics and contained in the same manuscript G (HUG 7, ff. 35-43), under the general title *Réflexions sur la probabilité de nos conclusions et discussion de la question de l'existence d'êtres vivants sur les autres planets* (OC, XXI, 529-562). All these writings, and especially *Verisimilia de planetis*, can be regarded as preparatory drafts of *Cosmotheoros* (HUG 34 A), which was the only one intended for publication and appeared posthumously in Latin (Huygens 1698a); it was republished by the editors of the *Œuvres complètes*, together with a French translation and commentary, in the same volume XXI (OC, XXI, 653-842).² In those late writings, Huygens deals with issues central

¹ The 'National Edition', Huygens 1888-1950, in the following OC.

¹ *De probatione ex verisimili* (1690), *Quod animalium productio, praesertim hominum, praecipuum sapientiae intelligentiaeque divinae sit opus* (1690), and *Insolitum spectaculum peregrino ex Jove advenienti* (1690).

² Even if there are some English translations of *Cosmotheoros* (e.g., Huygens 1698b), I will refer

to seventeenth-century philosophical debates: God's power, divine and human intelligence, probabilistic epistemology, natural theology, and the plurality of worlds. The powerful hybridisation of these ideas into an argumentative apparatus concerning life on other planets, plurality of worlds, and teleological interpretation of divine works, is not a casual feature, but rather an essential attribute of this mature phase of Huygens' thought and philosophical attitude.

The relevance of a thorough analysis of Huygens' mature works—ranging between 1686 and 1695—lies in the fact that problems related to the philosophical structures that support his scientific investigations remain unsolved. It is still difficult to articulate Huygens' conceptually autonomous and coherent vision, which has been denied or overlooked by prominent historians of science. On the one hand, the image of a scientist engaged only in the collection and analysis of facts and far from metaphysical concerns contributed to the exclusive appreciation of his still valid scientific results and his commitment to a 'modern' mathematical analysis of the physical world (Mach 1883; Cassirer 1907). On the other hand, the unresolved issue of his belonging to scientific Cartesianism, even if "heterodox" (Koyré 1965), led to the conclusion that Huygens' thought lacked a philosophical foundation. According to these scholars, Huygens was an exception in his time: a 'problem-solver, detached from the methodological, philosophical and theological debates that took place around him. This attitude might be among the main causes of the silence surrounding those late writings of his that are inspired by a greater reflective intention (Bos 1982), and do not easily fit in the opposition between such predetermined categories as Cartesianism and English Empiricism, that are often employed by historiography (Chareix 2003). In fact, the only studies that try to reconstruct the epistemology underlying his speculation ascribe it to a supposed Cartesianism (Elzinga 1972) or a lack of systematic thought (Burch 1981), and thus fail to highlight his peculiar way of expressing epistemic problems related to scientific theories. We have to recognize that Huygens' philosophical attitude has not yet been satisfactorily described.

A similar appreciation of his *Cosmotheoros*, and in particular of the most speculative sections in Book I, has been widely proposed by critical literature be-

to its edition in the *Œuvres complètes* where Huygens' writings were published in their original language.

tween the 1970s and 1990s. It was either regarded as the product of a mature wisdom (Hooykaas 1979; Andriessse 1993) or of a natural weakening (Romein 1977; Hall A.R. 1980) of Huygens's intellectual capacity. In this regard, the terminological analyses that has led to my English translation of the Latin draft *Verisimilia de planetis* support those studies that emphasize the philosophical features of Huygens' late writings without forgetting their relevance to his scientific activity (Mormino 2000, 2003a; Vermij 2002; Chareix 2003a, 2003b; Radelet de Grave 2003). Just like *Cosmotheoros*, which was described by his author as “un petit traité en matière Philosophique”,¹ they cannot be regarded as disconnected from his previous scientific work. Therefore, my analysis and English translation of *Verisimilia de planetis* takes into account not only the posthumous *Cosmotheoros* and the other late writings on similar topics, but also those parts of his works related to physical experiments where Huygens discusses methodological issues and criticizes ancient and modern philosophical approaches. In these mature writings on physics a theory of mechanistic motion emerges, which has been defined as “atomistic” (Mormino 2012). This raises a problem of interpretation concerning the teleology of Nature introduced in *Cosmotheoros* and its preparatory drafts.

Moreover, Huygens' late correspondence reveals not only his interest in the main post-Cartesian philosophical-scientific controversies but also his attention to epistemological issues. In particular in the correspondence with Leibniz Huygens' conception of matter comes to light, as well as his attempt, thanks to the stimulus of Newton's work, at converting scattered ideas about movement, strength, distance, and the cosmic system, into a consistent and “hyperphysical” (Mormino 1993) approach capable to connect his physical-theological arguments with the tenets of his mechanistic philosophy. According to the Dutch thinker, science does not concern the possible, but only the existing; thus, the endless variety of creation must not be assumed *a priori*, but it is necessary to rely on experience and, in its absence, on a probabilistic evaluation (Mormino 2012).

This article is organized as follows. Section 2 briefly introduces the contents and importance of *Verisimilia de planetis*. In Section 3 a terminological analysis

¹ Letter to Leibniz, 29th May 1694 (Huygens 1888-1950, X, No. 2854, 609). Cf. also Letter to Marquis de l'Hôpital, 24th December 1693 (Huygens 1888-1950, X, No. 2842, 577).

compares this late writing with a number of works by Huygens and his most relevant contemporaries. As a result, Section 4 presents my English translation.



2. Probable things about the planets

As early as 1660, in his *Eustachii de Divinis Brevis annotatio in Systema Saturnium Una cum Christiani Hugenii responso*, Huygens replies to Eustachio Divini and Honoré Fabri, who polemically interpret the marginal reference to the inhabited worlds in Huygens' *Systema Saturnium* (OC, XV, 179-353) within the thesis of pre-Adamitism (La Peyrère 1656). Here the Dutch scientist argues that for his hypotheses on the inhabitants of Saturn he relied on the habit of astronomers of placing imaginary observatories on other planets. And this idea is indeed not deemed ridiculous “among the philosophers” (OC, XV, 463).

Huygens points out on several occasions that the issue of the plurality of worlds and the existence of living beings on other planets in the same way as on our Earth is ancient. In his late writings, Huygens deals with the arguments of Greek and Latin philosophers such as Xenophanes¹, Anaxagoras², Plutarch³,

¹ Xenophanes is mentioned in the *Cosmotheoros* where Huygens explains that, in contrast to what the Presocratic philosopher believed, the moon cannot be inhabited due to the lack of water and breathable air (OC, XXI, II, 795). It is possible that Huygens read about this in Cicero, *Ac. II*, 123.

² *Verisimilia de planetis*, §2, 553; *Pensees meslees*, §45, 366; *Insolitum spectaculum peregrino ex Jove advenienti*, 562. Therefore, it is likely that Huygens implicitly refers to Anaxagoras in *Cosmotheoros*, I, 739 (OC, XXI).

³ *Verisimilia de planetis* §22, 553; *Insolitum spectaculum peregrino ex Jove advenienti*, 562; *Cosmotheoros*, II, 795 and 819 (OC, XXI). In addition, while discussing his *Discours de la cause de la Pesanteur* (1690) Huygens quotes Plutarch about the centrifugal force of the moon that counterbalances its gravity in the letter to Fatio de Duiller (OC, XXII, No. LXXVIII, 155).

Philolaus⁴, Democritus⁵, Lucretius⁶, and of early-modern ones, such as Nicolaus Cusanus¹ and Giordano Bruno². As we shall see, in view of his speculations in the *Cosmotheoros* Huygens proves his arguments on this topic in *Verisimilia de planetis* (§3).

This unpublished preparatory draft begins with a rhetorical question, in order to highlight a firm stance of Huygens: only those who have a solid knowledge of science (i.e., mathematics, astronomy, biology, etc.) can formulate hypotheses on the plurality of inhabited worlds, and judge his probable conjectures, which—like those of Galilei, Kepler and Wilkins—are not contrary to the Holy Scripture, as reaffirmed a few years later in *Cosmotheoros* (OC, I, 663). Furthermore, Huygens holds the thesis of inhabited worlds as “a probable opinion” (§1) to endorse the Copernican system. To this purpose, he intermingles astronomical and physiological observations with philosophical and theological arguments. Here, Huygens’ epistemology is extended to include, for the understanding of natural order, an argument from divine design: this was a common trait of seventeenth-century debates, since the collapse of the medieval symbolic interpretations of nature raised fundamental questions about the meaning of nature itself: divine design, providence and teleology were elements of a wider metaphysical conversation on the new mechanical conceptions of nature (Harrison 1998; Funkenstein 1986).



While in the *Appendice VI au Cosmotheoros* Huygens, as we will see below, explicitly mentions the *Entretiens sur la pluralité des mondes* of Bernard le Bovier

⁴ *Verisimilia de planetis* §21, 552(OC, XXI).

⁵ *Verisimilia de planetis*, §§21-22, 552-553; *Pensees meslees*, §11, 351, and §55, 369; *Discours de la cause de la Pesanteur*, 445. Therefore, it is likely that Huygens implicitly refers to Democritus in *Cosmotheoros*, I, 683 (OC, XXI).

⁶ *Pensees meslees*, §43, 364. It is likely that Huygens implicitly refers to Lucretius in *Cosmotheoros*, II, 817 (OC, XXI).

¹ *Pensees meslees*, §55, 369; *Cosmotheoros*, I, 683 (OC, XXI).

² *Pensees meslees*, §11, 351, and §55, 369, and *Cosmotheoros*, I, 683, and II, 817 (OC, XXI).

de Fontenelle as an “unscientific work” to be rectified (OC, XXI, 829), in his late writings and in particular in *Verisimilia de planetis* he takes into consideration and implicitly re-elaborates the arguments made by the greatest of his contemporaries, such as John Locke,¹ Gottfried Wilhelm Leibniz,² Robert Boyle and Isaac Newton.³

Huygens’ arguments in *Verisimilia de Planetis* are in continuity with his previous scientific work and can be interpreted as an evolution of his methodology of “esperientia ac ratio” (Chareix 2003a), culminating in what I would like to call *imagined experiences*. Here Huygens’ empirical investigation focuses, in a fruitful hybridisation with astronomical observations, on the physiology of animals and plants on Earth. His accurate description of the vital, perceptive and reproductive functions of animals, whether rational or not, becomes one of the focal points of Huygens’ arguments about the probability of life on other planets. If, from the Earth, Huygens’ rational animal has only limited visibility and understanding of all the infinite celestial spaces and bodies that God may have created, then the thesis that only our Earth is inhabited should be the least probable. In fact, it is precisely to contemplate the work of God, rather than for

¹ In chap. 3 of his *Elements of Natural Philosophy* (1689) Locke explicitly mentions Huygens’ astronomical and theological considerations. Cf. Locke 1824, 420-21: “Our solar system is distant from the fixt stars 20,000,000,000 semi-diameters of the earth; or, as Mr. Huygens expresses the distance, in his *Cosmotheoros*: the fixt stars are so remote from the earth, that, if a cannon-bullet should come from one of the fixt stars with as swift a motion as it hath when it is shot out of the mouth of a cannon, it would be 700,000 years in coming to the earth. (...) It is more suitable to the wisdom, power, and greatness of God, to think that the fixt stars are all of them suns, with systems of inhabitable planets moving about them, to whose inhabitants he displays the marks of his goodness as well as to us; rather than to imagine that those very remote bodies, so little useful to us, were made only for our sake”.

² In the *Nouveaux essais sur l’entendement humain* (book IV, ch. 16, §12) Leibniz explicitly mentions both Huygens and Fontenelle on the plurality of worlds. Cf. Leibniz 1923-, VI, 6, 472: “THÉOPHILE. C’est sur cette analogie que M. Huygens juge, dans son *Cosmotheoros*, que l’état des autres planètes principales est assez approchant du nôtre, excepté ce que la différente distance du soleil doit causer de différence; et M. de Fontenelle, qui avait donné déjà auparavant ses *Entretiens pleins d’esprit et de savoir sur la pluralité des mondes*, a dit de jolies choses là-dessus, et a trouvé l’art d’égayer une matière fort difficile: on dirait quasi que c’est dans l’empire de la lune d’Arlequin tout comme ici”. Cf. also book III, ch. 6, §22.

³ Cf. Section 3. Although this is not often recognized, the Dutch scientist thus contributed to influence Immanuel Kant’s thought about the existence of possible worlds and extraterrestrial life (Dick 1982; Crowe 1986).

the survival of the species, that Huygens recognizes a purpose in the animal senses—not only sight and hearing, but also the sense of pleasure—as well as in their inner soul, be it rational or not.¹ As can be seen from *Verisimilia de planetis*, in the midst of the confrontation between opposing seventeenth-century conceptions of the world, Huygens defines his animals by reinterpreting and combining elements of Cartesian *machinism* (cf. §21) with Aristotelian-Lockian *sensism* (cf. §8).

In this respect, Huygens' considerations on the generation of animals (Wolloch 2000) and of their souls, rational or not, may be considered as a pivotal moment of hybridisation between his understanding of mechanism and of the teleology of nature, since both approaches prove necessary to explain the functioning of the world machine in every part of the Universe, and thus the existence of a God who planned and created this perfect work. This neglected perspective on Huygens' *Verisimilia de planetis* and similar late writings, when adopted, reveals key elements of his rationality model and religious attitude. Huygens was not a mere 'problem solver', detached from the methodological, philosophical and theological controversies of his time (Marinucci 2021). Instead, he was involved in the most important debates, not only those regarding the possibility of extra-terrestrial life (Wolloch 2002), as we have seen, but also those concerning the mechanistic interpretation of the universe and of living beings, as well as animation and teleology.

3. Christiaan Huygens' intellectual vocabulary

The following analysis of the most relevant examples of Huygens' intellectual vocabulary (Russo 2012)—consisting of the terms *ratio*, *conjectura*, *verisimilitudo*, *imbecillitas*, *potentia*, *mirabilia*, *admiratio*, *sensus*, *animus*, and *voluptas*, and their collocations—is the backbone of my interpretation of the Dutch scientist's mature thought. Furthermore, it substantiates my English translation of *Verisimilia de planetis* (cf. Section 4), which is able to show not only Huygens'

¹ Thus, Huygens legitimately joins another important debate of the second half of the seventeenth century, that concerning the soul of beasts, a fact overlooked by most scholars (e.g., Marcialis 1982; Wright and Potter 2002).

reuse and hybridization of concepts and terms belonging to his wider scientific production, thus highlighting their diachronic and coherent evolution in a multilingual perspective, but also his implicit philosophical structures due to mutual exchanges with the philosophical thought of some of his contemporaries.¹

The frequent and polysemantic term ‘ratio’ required particular attention to find its appropriate English translations. The term could simply be translated with the equally polysemantic ‘reason’. However, I have tried to highlight specific nuances of ‘ratio’ based on its contexts. The translation with *reason* has been considered appropriate only in those cases where ‘ratio’ is synonymous with *motivation*—when e.g. Huygens interrogates himself with direct and indirect rhetorical questions (e.g., “Quae enim ratio afferri poterit cur (...) inertiae ac sterilitati”, §3)². Conversely, “recta ratione” (§1) and “tota Philosophiae ratio” (§21) have been translated with *reasoning*, intended as a synonym for *reflection*, *meditation*, etc., because in these contexts ‘ratio’ is associated with terms such as *philosophy* and *probable opinion*. Along these lines, the term ‘cogitatio’ (§2) has been translated in the same way, to highlight Huygens’ provocative comparison between his *right reasoning* (§1) and that of other philosophers (§2). These are most likely Descartes and his followers, from whom Huygens expressly dissociates himself countless times in his work and correspondence from the 1660s onwards, on both physical and metaphysical topics.³ The translation with *rea-*

¹ Future work based on this approach to Huygens’ work should consist in the definition of an extensive, multilingual, structured vocabulary linking together several writings. This could allow for a conceptual mapping capable of highlighting implicit philosophical structures, as well as the diachronic evolution of Huygens’ thought.

² Cf. *Verisimilia de planetis* (my emphasis): “Nulla autem *ratio* est” (§4); “non erat [*ratio*] cur” (§14).

³ Notable examples are two letters sent to Gerhard Meier (OC, X, No. 2686; No. 2711) in 1691—two years before the initial composition of *Cosmotheoros*—where the Dutch scientist underlines not only the errors of the French philosopher on the rules of motion, the celestial vortices, and the causes of the refraction of light and colors, but also his inability to demonstrate the existence of God and the immortality of the soul. In the same period, Huygens notes in his late draft *Appendice aux pieces ‘De rationi impervijs’* his objections to the proofs of the existence of God and its attributes, elaborated by Descartes in his *Principia Philosophiae* (Descartes 1677). In particular in §7, with the significant title *Des choses qui ne se peuvent comprendre par la raison humaine*, Huygens is willing to admit that Descartes demonstrated the existence of God, but not man’s knowledge of his attributes. To know the divine attributes, it is necessary to presuppose that man knows his intelligence and that within it there are different degrees of perfection, while in the Cartesian arguments the divine omnipotence, known in an innate way by man, appears to be only the human desire of such omnipotence that

soning and *motivation* is intended to stress the epistemological nature of the subject who observes and speculates on God's creation, which Huygens assumes to be perfectly ordered by means of the same *rules* ("rationes"), be they *astronomical, mechanical* or of *generation*, etc.,¹ in every part of the universe. This regularity is to be admired and investigated, and it is the counterpart to the capacity for knowledge. This is granted by God only to that *animal that is endowed with rationality* ("animal illud rationis particeps", §4)² and that enjoys the *use of it* ("rationis usu", §7)³ together with a solid knowledge of the sciences, especially geometry (§12) and music (§11), that are established on the *same principles*⁴ ("ijsdem principijs", §12) everywhere. Given that they are meant by God not only for us but also for the inhabitants of the other planets, Huygens concludes that "geometry is necessarily the same everywhere, and likewise the tones of music!" (§23). These statements make sense in the light of Huygens' earlier studies on the mathematical theories relating to musical consonances (OC, XIX, 361-65) and harmonic vibrations (OC, XVIII, 489-94), inspired by Pythagoras and Plato as well as Galilei and Kepler. In *Verisimilia de planetis*, and again in *Cosmotheoros* (OC, XXI, 729 and 749), Huygens reuses these scientific concepts and hybridizes them with his biological and astronomical observations so that they become a key argument for the possible existence of inhabitants on the other planets.

However, faced with the *immense and incomprehensible Nature* ("immensae et incomprehensibili isti Naturae", §21) created by God, Huygens will not be so arrogant as to assert anything for certain. In stark contrast to Newton's famous words "hypotheses non fingo" in the *General Scholium* of the second edition of the *Principia* (Newton 1713), which took aim at Huygens, among others (Kochiras 2017), the Dutch scientist prefers to *imagine conjectures and hypotheses* ("con-

man ascribes to God (OC, XXI, 526-27).

¹ Cf. also (my emphasis): "mirabili quadam *ratione*", "alia *ratione*" (§§8, 14); "non alia *ratione*" (§8); "artis mechanicae *rationes*", "generationum *ratio*" (§12); "eadem *ratione*" (§17); "optime est *ratio*" (§20); "astronomicis *rationibus*", "nulla *ratione* excogitare" (§21).

² Cf. also in *Verisimilia de planetis* (my emphasis): "*ratione* praedita animalia", "*ratione* atque organis quibusdam instructus" (§4); "*ratione* praediti incolae" (§5); "spectatores istos *rationis* compotes" (§6); "omnem eorum *rationem*" (§7); "*ratione* praedita", "in *ratione* pollutibus", "*rationis* particeps" (§14); "*ratione* praeditorum" (§21).

³ Cf. also (my emphasis): "*rationis* usum" (§§11, 17).

⁴ Huygens uses "legibus" (§§11 and 21) in the same sense.

jecturis ac hypothesibus fingendis”, §16)¹ to support the Copernican system and the plurality of worlds. In fact, it is very probable that across *immense spaces* (“*immensa spatia*”, §21) there are many Suns and stars too far from us, which we can perceive only as an *incomprehensible multiplicity* (“*incomprehensibili multitudine*”, §21).



As we read in *Cosmotheoros*, Huygens thinks that Giordano Bruno’s conception of an infinite universe is not unreasonable, but nothing prevents that, beyond the region of the stars, God has created other innumerable things far from us and from our reasonings (OC, XXI, II, 817). These considerations show us Huygens’ peculiar epistemological stance, already elaborated in two preparatory drafts. First in the *Pensees meslees* (1686) where Huygens writes:

L’estendue du monde estant infinie, si le nombre des estoiles est fini, il est croiable qu’au de la il y a une infinitè d’autres choses creees dont l’idee ne tombe point en notre pensee. Cependant rien n’empesche d’imaginer le nombre des estoiles si grand que l’on veut, car de ce peu que nous en voions il n’y a point de consequence a tirer pour leur multitude (OC, XXI, §59, 371).²

Then in §21 of *Verisimilia de planetis*, where Huygens concludes: “Imo cum hoc immensae et incomprehensibili isti Naturae magis conveniat, ut longe plura ulterioraque operetur, quam quae vel suspicari possit imbecillitas nostra”.³ Here, Huygens’ use of ‘*imbecillitas*’, which can be translated as *intellectual weakness*, is particularly significant. It recalls similar considerations on the impotence of man, “who, in all probability, is one of the lowest of all intellectual beings” (Locke 1824, 117; IV, 3, §23) expressed in Locke’s *Essay*, which Huygens greatly appreciated, as stated in the correspondence with his brother Constantijn and

¹ Cf. also: “*conjectura*” (§13); “*conjecturas et verisimilitudinem*” (§15).

² French texts are reproduced without modernization.

³ Cf. Section 4 for the English translation.

Nicolas Fatio de Duiller between February and March 1690 (OC, IX, No. 2558; No. 2567; No. 2572). Huygens seems to agree that the human *power of understanding* (“*intelligendi vim*”, §18), granted by God to man only to a limited extent, is a complement to the infinite power of God (“*immensa Dei potentia*”, §6).

Subsequently, in the *Cosmotheoros* the term ‘*imbecillitas*’ will be used by Huygens to underline the incorrect use of reason by men, above all those who are part of the sect of Christians, when clouded by false beliefs and prejudices (OC, XXI, 743). Therefore, our ‘*imbecillitas*’ is precisely the reason for our need to make conjectures and to learn how to distinguish what is *probable* (“*verisimile est*”, §10), especially in astronomical discoveries. In fact, in the *De probatione ex verisimili* (1690), the Dutch scientist is particularly severe against those who fail to discern the “*gradus verisimilium*” (OC, XXI, 541) of conjectures. It is only by this method of hypotheses that the immense difference in probability between the Copernican and the Tyconic system becomes evident (contrary to what is claimed in works of astronomy such as Cassini 1684). In the *Préface* to the *Traité de la lumière*, Huygens uses the French formula “*degré de vraisemblance*” (OC, XIX, 454) to explain his method, which he had been developing since his youthful work on probability (*De rationis in ludo aleae*, OC, XIV, 1-91), combined with the use of classical deduction (Shapiro 1989), thus producing a methodology of conjecture that is applicable to philosophical speculation. If Huygens’ leading role in the field of probability is acknowledged (Daston 1988), his use of probabilistic reasoning as a philosophical methodology—that can be found in the *Traité de la lumière*, as well as in *Verisimilia de planetis* and other late writings leading to *Cosmotheoros*—has not yet been fully recognized. Yet, probabilistic reasoning was already addressed in the philosophical treatises of his contemporaries. In particular, it is worth underlining the similarity with the reflections contained again in Locke’s *Essays* not only regarding the various degrees of assent “concerning things, which being beyond the discovery of our senses, are not capable of any such testimony” (Locke 1824, 233; IV, 16, §5) but above all regarding the usefulness of analogy to conjecture the existence of inhabitants on other planets.¹

¹ Cf. “§12. *In things which sense cannot discover, analogy is the great rule of probability.* (...) There remains that other sort, concerning which men entertain opinions with variety of assent, though the things be such, that, falling not under the reach of our senses, they are not capable of testimony.

Therefore, as Huygens explains on several occasions in *Verisimilia de planetis* and other late writings,¹ without the mastery of this probabilistic knowledge, men mistakenly give faith to the prophecies of *divinatory astrology* (“astrologiam divinatricem”, §18). This sheds light on his criticism, in the incipit of the second book of *Cosmotheoros* (OC, XXI, II, 765 and 767), of Athanasius Kircher’s *Iter extaticum* (1657). The Jesuit’s improbable conjectures fall within astrology—in particular those refuting the motion of the Earth and life on other planets, which instead are part of the many ‘mirabilia’ of creation. In *Verisimilia de planetis*, the first occurrence of this meaningful term (§3) refers to more concrete realities, such as seas, mountains, various types of animals, etc., while the second occurrence (§23) is referred to more abstract ones, such as the inventions of geometry and algebra.

Later, in *Cosmotheoros*, Huygens will use “mirabilia” (OC, XXI, 759 and 787) and “miraculum/a” (OC, XXI, 701 and 789) interchangeably. This has led me to translate it with *miracles*, also in consideration of its frequent association with other terms such as “admiratio”, “admirari”, “mirabilis”, etc., that emphasize Huygens’ exhortation to contemplate God’s work as an *admirable spectacle* (“admirandum spectaculum”, §19). Especially the ‘ratio’ of animal generation is *admirable* (“mirabilis ac divina est nostrarum generationum ratio”, §14),² since such *miracles* fall under the mechanical laws of nature. In fact, according to the *Préface* of the *Discours de la cause de la pensanteur* (1690), according to Huygens there was not a unique creation of animals but many creations over time (OC, XXI, 436). If the phenomenon of generation remains one of the most controversial topics in his late reflections, as shown by the expression “generationis mysteria” in another late draft *Quod animalium productio* (OC, XXI, §1, 555), however in *Verisimilia de planetis* it is clear that for Huygens those ‘mirabilia’

Such are, 1. The existence, nature, and operations of finite immaterial beings without us; as spirits, angels, devils, etc. or the existence of material beings; which either for their smallness in themselves, or remoteness from us, our senses cannot take notice of; as whether there be any plants, animals, and intelligent inhabitants in the planets, and other mansions of the vast universe” (Locke 1824, 237; IV, 16, §12).

¹ Cf. *De probatione ex verisimili*, 541; *Que penser de Dieu*, §5, 343 (OC, XXI).

² Cf. also: “mirabili quadam ratione” (§3); “mirabilem motus naturam, mirabili rerum (...) varietate” (§6); “uti mirabili industria” (§8); “mirabilis (...) est oportunitas” (§11); “mirabiles progressus”, “mirabiles apparenctiae” (§12); “mirabili varietate” (§13).

are an example of the *immense power of God* (§6), as he also previously noted in the *Pensees meslees*:

quand on considere les animaux et les plantes, l'admirable construction de leur parties pour chaque usage, la maniere estonnante de leur generation, il me paroît impossible que le seul mouvement donnè a la matiere puisse estre cause de tout cela sans la cooperation d'un Estre infiniment intelligent et puissant. (OC, XXI, §42, 363)

Therefore, as opposed to Descartes' world machine (Descartes 1664/1909), God is always engaged in his many creations over time, as the world machine continues to function according to his design, as explained in §21 of *Verisimilia de planetis*:

Quanto vero etiam majorem Dei conceptum praebet, tot ac tam variarum rerum creatoris, quas ijs legibus eaque arte constituerit ut veluti machinae totidem affabre confectae sponte moveri quancunquē tempore possent, nihilque ijs accideret quod non ipse praevidisset.¹

In the “cosmological determinism” (Marinucci 2021, 649) of Huygens' mature thinking, the miraculous creation of animals, rational or not, and their parts, is a core issue. This is one of the main reasons why, in *Verisimilia de planetis*, the Dutch scientist dwells on their detailed descriptions. Reasoning by analogy, Huygens imagines their nature and *sensitivity* (“sensu”, §5),² understood as the general ability to perceive through various type of *senses* (“sensus”, §6).³ For Huygens it is reasonable to hypothesize that the inhabitants of other planets are endowed with senses relating to the external perception of objects. Specifically, these are the *sense of sight* (“videndi sensum”, §16), through eyes perfectly constructed by God, such as ours are, and the *sense of hearing* (“auditus sensu”, §11) necessary to communicate and escape from dangers. Again, Huygens repurposes here concepts and terminology from his previous scientific studies—in particular those on sound and voice (OC, XIX), and on the harmony of singing

¹ Cf. Section 4 for the English translation.

² Cf. also: “de sensu Planetariorum istorum animantium” (§6); “nervulorum sensu[s]” (§8); “sensu percipiuntur” (§14).

³ Cf. also: “hoc sensu destituta” (§6); “sensuum voluptatibus” (§7); “imagines sensibus referret”, “sensibus adaptare” (§8); “auditus sensu”, “praestantem sensum” (§11); “voluptatis sensu” (§14); “videndi sensum” (§16).

(OC, XX), as well as those on the light (OC, XIX), and on the anatomy of the eye and on the mechanism of vision (OC, XIII)—and hybridizes them with his probabilistic reasoning to argue the main characteristics of inhabitants on other planets. The most relevant example is the description of the process of visual perception in *De l'œil et de la vision* (1690) where the Dutch scientist makes a meaningful correction by replacing “notre sens” with “notre ame” (OC, XIII, 791). Also, later in the same draft Huygens assimilates the *soul* (“ame”) to an *internal sense* (“sense interieur”):

F est le nerf optique qui se termine au cerveau et dont les fibres tres subtiles s'estendent par toute la surface interieure du creux B, recevant dans leur extremittez l'action de la lumiere et raportant ainsi l'ordre et les couleurs de la peinture des objects a nostre ame ou sens interieur. (OC, XIII, 794)

A very similar description is given in *Verisimilia de planetis*, where Huygens explains that the functioning of sight is due to an “interior animus” (§8) capable of judging color, distance and the position of things seen through the eyes. My choice of translating it with *internal sense* aims to highlight also its similarity with that “internal sense”, understood as the faculty of perceiving mental states, which Locke defines “reflection”, borrowing the image from optics (Locke 1689/1924, II, I, §4).

Furthermore, in Huygens' probabilistic arguments about the physical appearance of the inhabitants on the other planets, it is reasonable that they also have hands (“manus”, §8), defined as *instruments* (“instrumenta manuum”, §9¹) of a carefully crafted body, as they allow to handle objects, machines and other important *instruments* (“instrumentis”, §16²), such as telescopes (§§10, 16, 21). For this reason, it is precisely the use of hands that makes land animals superior to the flying ones, since hands make possible those activities usually performed by *animals endowed with reason* (§4), such as observing the sky with instruments. It is worth emphasizing that Huygens underlines the importance of scientific instruments in *Verisimilia de planetis*. Having devoted many efforts to the conception and construction of telescopes and microscopes for his dioptric studies from the early 1650s onwards (OC, XIII), now Huygens focuses on a

¹ Cf. also: “instrumento” (§8).

² Cf. also: “organis” (§4).

more general perspective. Those instruments, being used through God-given senses, are their extension to better understand and admire the perfection of divine work. Not only the heavens and the movements of celestial bodies, but also the generation of animals and the construction of their parts show the existence of divine *providence* (“*providentiae*”, §9), as already argued in the *Pensees meslees*:

De sorte que la grandeur des cieux et ces inconcevables distances des astres dont j’ay parlè cy dessus prouvent bien moins a mon avis l’existence d’une providence que l’œil d’un homme ou d’un autre animal ou l’aile d’un oiseau. (OC, XXI, §42, 363)

The same arguments on the evidence of divine providence in the created world are included in the first philosophical book of the *Cosmotheoros* (OC, XXI, 715).

Last but not least, in *Verisimilia de planetis* we find the first reference to Huygens’ conception of *pleasure* (“*voluptates*”, §14), which is the supreme and best gift of God, so much so that it cannot have been given only to the inhabitants of the Earth: “*Voluptas autem summum optimumque est Dei donum, ideoque et illa in quibus maximè sita est, non hujus tantum terrae habitatoribus tributa putentur*”.¹ Among the various pleasures with different purposes, the most physical and primal is the *sense of pleasure* (“*voluptatis sensu*”, §14), understood as *desire*, which comes before those perceived by the other senses and is granted by God to all animals everywhere for their reproduction. Similarly to Locke (1689/1824, II, XI, §11), in his *Cosmotheoros* Huygens defines as cruel and absurd the opinion of some philosophers who deny *every sense* (“*sensuum omnem*”) to animals and reduce them to mere automata. He maintains instead that animals are able to enjoy *bodily pleasures* (“*voluptates corporis*”), just as rational animals do (OC, XXI, 731). There is a strong continuity between rational and nonrational animals, which are similar in their primitive needs and perceptions. However, already in *Verisimilia de planetis* Huygens states, in addition to a physical type of pleasure perceived thanks to the senses (“*sensuum voluptatis*”, §7), the importance of a more rational type of *pleasure* (“*voluptatem*”, §3), experienced through our mind (“*animi oblectationem*”, §19) when we make conjectures and admire God’s works. This rational pleasure is particularly evident

¹ Cf. Section 4 for the English translation.

in the harmony of geometry and music, which, as we have seen, are the same everywhere (§23), as he will repeat in *Cosmotheoros* (OC, XXI, 751). Human beings can perceive this type of pleasure only with the mind and the sense of reason (*rationis sensu*), aimed at the study of science, inventions and the discovery of truth (OC, XXI, 727). The Dutch scientist focuses on the use of reason rather than its possession: if something should be doubted, it is not the senses, but the correctness of the conjectures.



4. English Translation of *Verisimilia de planetis*

Probable things about the planets

What wouldn't the ignorant in astronomy and philosophy dare to object against these disciplines, to the applause of the vulgar?

§ 1.

It is convenient that those for whom these things are written prepare themselves by reading the books which demonstrate the truth of the movement of the Earth, and that neither this [truth] nor the existence of several earths are contrary to Holy Scripture, such as Galileo's dialogues, Wilkins' [inhabited] world of the moon,¹ Kepler's [works], etc.² I do not want to transcribe what can

¹ According to the catalog of books owned by Huygens (cf. OC, XXII, *Catalogus librorum*, Libri Mathematici in Duodecimo, No. 39, 13; *Libri Math. in Octavo*, No. 49, 12.), the Dutch scientist had John Wilkins' work both in the English original version, named *Discovery of a new world, or a discourse tending to prove that it is probable that there may be another habitable world in the Moon* (1638) and in the French translation, named *Le monde dans la lune* (1656).

² Cf. Section 2.

be read in so many authors. So I ask that they have a non-superficial knowledge of astronomy, and above all of its physical part. Without this [knowledge, my readers] will not be able to judge this little work correctly, neither their censure will have much value for me, if they prove these things to be false or condemn them, or mock them. Those authors rejected also those things that can be opposed by the precepts of philosophy. On the contrary, according to philosophy itself and *right reasoning*¹ we will conclude what is our *probable*² opinion.

§2.

Worthy is the topic we will deal with.³ Therefore, I am surprised by those who consider themselves to be scholars of philosophy, while they don't rise up to it with [their] *reasoning*.⁴ As those who visited many kingdoms and peoples through long journeys abroad judge their homeland in a wiser and better way than those who never set foot outside it, so the one who is accustomed to turn [his] mind among the stars, and from there to contemplate this globe of our Earth, often considers how small this particle of the universe is, and also what happens elsewhere in so many thousands of worlds. How small then are these kingdoms, what [are their] activities, what [are their] orbits?

§3.

Let us consider this system of planets around the Sun, the diagram⁵ of which is depicted here, as if we were placed on the outside of it. The Sun [is] like the

¹ *recta ratione*.

² *probabilis*.

³ This incipit is very similar to the quotation from Seneca in another manuscript in which Huygens deals with similar cosmological issues, such as in particular the presence of inhabitants in the other planets of the Universe. Cf. folio 132, *Chartae astronomicae* (HUG 28): “Digna res est quae quaeratur, ait Seneca [writing about the earth considered as the center of the world, but perhaps turning around its axis], pigerrimam an velocissimam sedem nacti simus, omnia circa nos an nos ipsos circumferat etc. La question est encore plus considerable a mon avis, de scavoir si nostre Terre seule porte des animaux et des creatures douees de raison, ou s’il y a dans l’univers plusieurs terres avec des habitans aussi remarquables”. See *Nat. quaest.* VII, 2: “digna res contemplatione, ut sciamus in quo rerum statu simus, pigerrimam sortiti an velocissimam sedem, circa nos deus omnia an nos agat”.

⁴ *cogitatione*.

⁵ There is no drawing in the manuscript, *Ed.*

loin in the middle of five globes that revolve around it with orbits of different sizes; all are illuminated by its light, to be sure, the closest ones more strongly and more intensely, the farthest ones more faintly; and each of them rotates around itself in a certain interval of hours, during which the whole surface brightens alternately for that light.



Moreover, when one notices that all these globes with so many names surrounding the Sun are similar to each other, can it seem *probable*¹ to anyone that in one of them, and among the smallest, there are many *miracles*² such as seas, mountains, woods, rivers, animals of many kinds, some walking on four legs, others with two, others flying in the sky, others living underwater, all of which produce beings similar to themselves according to a *certain admirable rule*³; while instead in the other allies and associates of the same chorus [there be] nothing but matter reflecting the rays of the Sun, without evident variety, and endowed only with rocks, stones and sands in a vast wilderness? (It is in fact necessary to grant them a certain corporeal matter from which the reflection of light is produced). *What reason indeed could be given why*⁴ all those things are granted to only one [globe] in preference to the others, while the rest are denied of any use, and condemned to eternal inactivity and sterility?

When we understand that the trees known to us bear some fruits or acorns, we do not doubt that even those which we see far away in unknown islands, produce something of the same kind apart from the leaves.

Only the satellite of the third planet from the sun will offer light to the animals at night, but the four of the fifth planet will be of no use, and likewise the five placed around the farthest one. Therefore, if a similar variety and beauty of

¹ *probabile.*

² *mirabilia.*

³ *mirabili quadam ratione.*

⁴ *Quae enim ratio afferri poterit cur.*

things flourishes in other planets and in this Earth of ours, it will be deprived of a spectator! Just as the elegance and ingenious creation of animals, the colors of the flowers and the smells seem predisposed to the *admiration*¹ or *pleasure*² of men, so also in these [planets] there will be someone who enjoys so many and pleasant *spectacles*³.

§4.

Imagine that mankind has disappeared and is annihilated. Will not all these things seem to be in vain? Will not the Earth be left without any culture? A bleak desert and a dwelling place for beasts?

Indeed, is not man himself, that *animal partaker of rationality*⁴, to be considered by far the most special part among those that exist on Earth? Can he, who is able in so many disciplines, who [is] *instructed by means of certain instruments and of rationality*⁵, recognize the movements and distances of celestial bodies? [That one who] builds houses, ships, clothes, machines of all kinds with such industry. Finally, the only one who is capable of contemplating and admiring the divine works. Although indeed the purposes the creator intended are not clear to mortals, it appears however that it seemed right to him that there were *animals provided of rationality*⁶ who could contemplate his infinite wisdom, and recognize its benefits.

Therefore, if the remaining Planets lack living beings of this nature, they will surely be much inferior and of lesser value than ours. *There is no reason*⁷ to consider them less endowed with all those things, nay, there is reason to estimate that the major ones such as Jupiter and Saturn have achieved a greater excellence. Therefore, they will not be lacking of particular animals, which shall be equated with mankind, and perhaps even far more perfect.

In truth no one should believe that this is in any way prevented by the fact that the inhabitants on Mercury planet appear to be burned by a heat ten times

¹ *admirationem.*

² *voluptatem.*

³ *spectaculis.*

⁴ *animal illud rationis particeps.*

⁵ *ratione atque organis quibusdam instructus.*

⁶ *ratione praedita animalia.*

⁷ *Nulla autem ratio est.*

greater than ours, or by the fact that on Saturn, by experiencing one hundred times less, they seem iced up in a perpetual frost. Why isn't it possible that animals, trees and any other grass have adapted and are hardened against those different temperatures? In fact, it is clearly nonsense to say that in our distance from the Sun the heat is considered moderate and the light supplied in the right measure, while in those others they are abundant or lacking. It is indeed refuted by these same differences that can be observed on this Earth. Since the Hyperboreans of Samoyedia endure a climate much colder than those who live in central Africa, and yet neither these nor those lament their fate.

§5.

Hereafter, having placed the animals that live on the surface of the Planets, it remains to be seen whether we cannot conclude something more about their nature and their *sensitivity*¹.

Since we contemplate various figures among our animals, quadrupeds, birds, fishes, crabs, tortoises, snakes, insects; and again in each particular one [we observe] such a great diversity of forms, such as [that] of the horse, elephant, pig, deer, porcupine in the quadrupeds; [that] of the eagle, peacock, owl, bat, *grand bec*,² ostrich in the birds; [that] of the whale, race, cuttlefish, hippopotamus, crocodile, oyster, sponge, plaice,³ shells, seal⁴ in the fishes or amphibians; and finally the varieties of insects. Considering all these [varieties], we will easily believe that by no means we can ever predict which figures of animals inhabit the regions of the planets so far away. Particularly given that in the lands of America different [animals] than in the remaining parts of the globe have been discovered, and also plants and many trees dissimilar from all ours.

Nonetheless, by reviewing the main varieties of animals known to us and in which ways they move, everything leads back to this, [that] either they fly

¹ *sensu*.

² Huygens possibly uses this French expression, according to the editors of OC, to refer to a pelican. In Richelet's *Dictionnaire* (Richelet 1680, I, 72, s.v. Bécasse), we read: "*bécasse à cause de son grand bec*". There are in Huygens no other references to a bird with a 'big beak': *Verisimilia de planetis* being a draft, he lists a series of animal names that he remembers in various languages (i.e., *schol* and *veau marin*) without bothering to look up their Latin denomination.

³ *schol* – Dutch name for the plaice.

⁴ *veau marin* – French name for the seal.

through the air rowing with wings, or they walk on the earth by foot, or they crawl without feet, or they open their way through the water with the energetic winding of bodies or with the thrust of feet. Beyond these ways of moving, it seems scarcely possible that other exist or be conceived. Therefore, those animals that live on the planets will move in one or the other of these ways, or some even in several ways at the same time, like the amphibious birds here by us, which both advance on the earth on foot, and swim in the water, and in the air. No fourth way of life beyond these seems to be conceivable. What could indeed exist there except the solid earth, the liquid element, and the air or something similar to it? (Indeed, the air could be denser and heavier than ours, and therefore more suitable for birds). Quite clearly, these things are undoubtedly such that nothing else can exist.

How truly happy these inhabitants distinguished and *endowed with rationality*¹ [are], if they dominate this threefold faculty. So that nevertheless nothing bad ensues from this. In fact, if they enjoy such advantage, it is necessary that enmities and wars do not exist among them in the same way as on this Earth of ours, because otherwise they could not live without risk or safely, since they would always be exposed to unforeseen invasions by a winged enemy.

§6.

Let us examine further the *sensitivity*² of the animated beings of these Planets. For my part I am absolutely convinced that they are *gifted with sight*³. What existence [would they have] indeed without *sight*, in what way would they be able either to avoid dangers or to obtain food, if they lacked this *sense*⁴? In this [there is] the greatest help for life, nor it can happen that where animals exist, they are deprived of this greatest gift of all. And so, in every kind of animal that exists here with us, we observe the *use of the eyes*⁵ by terrestrial, avian and aquatic animals, and also by insects; only some animals of very little value, such as earthworms and small worms, are exceptions. Since if we examine the divine

¹ *ratione praediti.*

² *de sensu Planetariorum istorum animantium.*

³ *visu praedita esse.*

⁴ *hoc sensu destituta.*

⁵ *oculorum usum.*

invention of light that extends from the Sun to the other planets in the same way as to the Earth, we will surely not regard this *admirable nature of motion*¹ as created more for us than for everyone else. First of all, it is indeed credible that these *spectators in possession of rationality*,² of whom we have spoken, have the power of sight, with which they enjoy both the *admirable variety of things*³ on earth and the perception of celestial things, in the form of the sun, of the moon, of the stars and of the whole universe, in which especially the *immense power of God*⁴ shines. Could it really be that the contemplation of these things will only be given to us inhabitants of the earth, while those who live elsewhere become blind towards such things?

[*In the margin:*] sight, hearing, the other *senses*,⁵ *generation*,⁶ food, speech, *pleasure*,⁷ arts, sciences, necessarily the same mathematics, the same music generally, astronomy.

§7.

If you take away from men the *contemplation and admiration*⁸ of natural realities and the works of God, what else would they achieve with the *use of rationality*⁹ apart from what beasts and birds have without it, since these by nature live serenely among themselves, and do not lack food and clothing, nor *pleasures of the senses*¹⁰.

I acknowledge indeed that the greatest part among terrestrial men hardly turn their *mind*¹¹ to these things, or consider examines lightly, since a long

¹ *mirabilem motus naturam.*

² *spectatores istos rationis compotes.*

³ *mirabili rerum (...) varietate.*

⁴ *immensa Dei potentia.*

⁵ *visus. auditus. sensus caeteri.*

⁶ *generatio.*

⁷ *voluptas*—it is difficult to discern the kind of *pleasure* Huygens is referring to: the physical one coming from the *senses* or the rational one coming from the *mind*. It can be argued that he is thinking of both, since the term is in the middle of a climax of God's gifts, starting from the most physical ones given to all animals to the most abstract ones given only to those animals endowed with reason.

⁸ *contemplationem et admirationem.*

⁹ *rationis usu.*

¹⁰ *sensuum voluptatibus.*

¹¹ *animum.*

acquaintance lets even such great things lose their value. However, the wisest admire them constantly and contemplate their Author. Some people investigate thoroughly *all the reasons*¹ [of these things] and, although at every moment they are few, nevertheless the succession of the centuries produces throughout a not small number of them.

§8.

Let us then attribute the eyes to these animals too. Certainly, the *structure of the eyes*² is adequate to an *activity so marvelous*³ that it seems that it could hardly have been undertaken for a *different reason*⁴ than that of bringing distinct images of external realities to the *senses*⁵. In fact, the light rays, which extend from single points to the orb of the pupil, are connected again to single points by means of the refraction of the convex surface, and they modify⁶ the *sensitivity of the small nerves*⁷ that are thinly scattered in the back of the eye and whose weave composes that film called the choroid, so that the *internal sense*⁸ judges thence the color, the distance, the position of things. Nature uses this same mechanism in all kinds of our living beings, so that it is credible that *according to no other rule*⁹ [Nature] could adapt so well the benefit of light to the *senses*¹⁰. Therefore, why this same [*rule*] should not be followed in these regions as well, since [Nature] would nowhere choose but the best. Therefore, those animals also have eyes; and they also have two, by which they observe the same thing at the same time; since some intersection of the rays is needed to judge the distances of nearby things. Indeed, it is more dangerous to walk without a knowledge of distance, nor a collision with things that will cause harm is equally well avoided. They also have [the eyes] placed in the upper part of

¹ *omnem eorum rationem.*

² *oculorum fabrica.*

³ *uti mirabili industria.*

⁴ *alia ratione.*

⁵ *imagines sensibus referret.*

⁶ *afficiunt.*

⁷ *nervulorum sensu[s].*

⁸ *interior animus.*

⁹ *non alia ratione.*

¹⁰ *sensibus adaptare.*

the body: if we recognize that they are placed in that place correctly and wisely and that they could not be placed so well elsewhere, we should indeed affirm a lack of wisdom in placing them in a lower part.

Maybe they also have hands? It does not seem that something can be produced accurately without such an *instrument*¹, nor that those things that are required in the observation of celestial bodies can be properly handled or arranged.

A vastly different depiction of the universe is offered to the *mind*,² when we conceive countless Earths and in each individual one a variety of things and animals no less than what we observe here before us. Since it was commonly thought that there is only this one Earth of ours that contains all things of this nature, the stars were thought to be nothing more than certain luminous globes affixed in the convex surface of the sky.³

How much greater and more excellent [is] that work, so much multiple of infinite variety; and how much more [is it] worthy of God. In fact, the totality of the world is not simply divided into sky and Earth, but we are in the sky, and we rotate around as companions of a great star, which is but one among many.⁴

§9.

On the determination of *providence*⁵ in created things, especially regarding the limbs of animals. Volatile animals would be superior to land animals, if the *instruments of hands*⁶ were not required for machines and for the observation of the sky. In the remaining [activities] the birds have a better fate. The stork, in an extraordinary passage.⁷ What if on a planet both were combined into one genus?

¹ *instrumento*.

² *animo*.

³ This passage is similar to the *Appendice III au Cosmotheoros* (OC, XXI, 824).

⁴ Similar considerations are also found in the *Pensees meslee* (OC, XXI, §§11, 28, 37).

⁵ *providentiae*.

⁶ *instrumenta manuum*.

⁷ According to the editors of OC it is not possible to identify the passage to which Huygens refers, and they exclude a reference to Plinius' passage about storks (*Nat. hist.* X, 31) as uninteresting. An example of the kind of passages Huygens might have had in mind could be this one from a seventeenth-century dissertation on storks: "Cum enim mu[]ta animalia manibus careant, quibus apprehendant cibum; non possent illum de solo colligere, nisi cruribus longioribus, pariter collum

§10.

What could be different, in the planets, from the things that are in ours? What could be better? Many things for sure. When we examine other things granted to us or discovered by us, such as the art of writing, and of *telescopes*,¹ the knowledge of geometry, of logic, of the calculus of logarithms, and of typography; as it cannot easily be conceded that these are known on the other Planets, so *it is probable*² that some other things are found there that are not inferior, so that we do not surpass [them] too much with our things.

§11.

About the *sense of hearing*³, it must also be seen whether even here in these remote lands it is attributed to animals.

[*In the margin, in French:*] If they have the air, which serves to preserve the fire, is necessary to breathe, and is used for navigation. Marvelously adapted to *hearing*.

Which is suggested by many [evidences]. First, indeed, this perception favors above all the preservation of life; given that an imminent danger is often known through a sound or a noise, especially at night, when the help of the eyes is lacking. In addition, each animal calls its fellows by the sound of its voice, and they indicate many things to each other. Among those [animals] indeed who have the *use of rationality*,⁴ whose genus has just been said to be found there too, how great and what *admirable is the opportunity*⁵ offered by the voice and hearing; hence it is not credible that such an *excellent sense*⁶ and such an artifice of

proportionatum responderet. Sapientissimus autem Deus, ciconia, ardea, ibi, similibusque avibus longiora crura concessit, quod ex locis uvidis & paludosis, quæ vestigij minus patientia sunt, victum suum colligere soleant” (“Since many animals lack hands with which to grasp food, they would not have been able to pick it up from the ground unless their legs were longer and their neck equally proportionate. But the most wise God has granted storks, herons, ibises, and similar birds longer legs, because they are accustomed to collect their food from barren and marshy places, that do not support well their footsteps”; Schoock 1648, f. B1v).

¹ *telescopiorum*.

² *verisimile est*.

³ *auditus sensu*.

⁴ *rationis usum*.

⁵ *mirabilis (...) est oportunitas*.

⁶ *praestantem sensum*.

speaking has been devised only on our Earth and in our favour: how indeed could they not miss much of our happiness, if they lacked such a great benefit, or something else that can compensate it. Finally, shall we believe that even the sounds of music and their sweetest accords are given only to us who are endowed with intelligence, when all the science of harmony comes from a certain fixed and immutable nature, such that in no land and among no people it is not regulated by the *same principles*,¹ as regards the intervals of sounds and the consonant distances.

§12.

Furthermore, Geometry has the same [property], and even in a more manifest way, since everywhere it is found, it is based on the *same principles*.² And so, this too is one of the arguments for believing that [Geometry] is not ours alone, nor is it granted and destined only for mankind. But there are also other [arguments] that confirm this even more. Can it be that indeed we only inhabitants of this Earth will observe the course of the stars, and measure their distances and the size of the universe? Will we alone investigate the orbit and surface of our globe? Then will we only know the *rules of the mechanical arts*,³ and all the advantages that derive from this study, while everyone but us lack them? Yet in these things especially the use and superiority of the *rational soul*⁴ are so manifest that those who master the knowledge of these things excel so much over other men as men over the lower animal genus. I really do not see what benefit the inhabitants of other planets might have received that would be comparable to this. Since if we merely consider the star of Jupiter, or Saturn, and the great incitement and opportunity for the study of Astronomy that are granted to their inhabitants by so many satellite Moons and their frequent eclipses, it will seem absurd that no science of these things exist there, given that among us, who are so easily distracted and provided with a much simpler complex [of satellites], it has made such *admirable advances*.⁵ Isn't it possible that such frequent eclipses

¹ *iisdem legibus.*

² *iisdem principijs.*

³ *artis mechanicae rationes.*

⁴ *rationalis animae.*

⁵ *mirabiles progressus.*

of Moons and Suns will incite the inhabitants of Jupiter and Saturn to know the causes of such prodigies? Even the various and *admirable appearances*¹ of the ring of Saturn which, while sometimes at night it is seen in the form of a large shiny circle, at times instead intercepts the sunlight for many days, will not these things so admirable, I say, lead the inhabitants of Saturn [to do] the same, even if they were reluctant? Reasonably, if the eclipses of our Sun and our Moon incited men to the study of the stars, so many motion and reciproca-tions should have acted much more on the inhabitants of Saturn. Truly, I would believe that the inhabitants of both these planets, if they go there by sea with ships, possess not only this art, but also a very accurate Geography of their globe and the determination of the Longitudes. Why would they not sail, being able to do it more easily than us, and with less danger?²



§13.

But it will be said that, perhaps, we have brought forward this *conjecture*³ more boldly than it is appropriate. It cannot be denied that these almost daily Eclipses and the conjunctions of the moons are seen with an *admirable variety*⁴ in those regions. It is also evident that the continuous succession of nights and days is preserved there, since we know the length of the day on Jupiter and Mars. In fact, Jupiter exposes its entire surface to the sun in about 10 hours, [while] Mars, like our Earth, in almost 24 hours. And who will doubt that Saturn, Venus and Mercury follow the nature of the others, even if their periods have not yet been observed? Furthermore, I suspect that on the planet Saturn there is the

¹ *mirabiles apparentiae*.

² Cf. *Cosmotheoros*: “Praesertim verò in Jovis Saturnique maribus commoda esset navigatio propter Lunarum plurium utrobique copiam; quarum ductu longitudinum mensuram, quam vocant, quae nobis non contigit, facile consequi possint” (OC, XXI, 749).

³ *conjectura*.

⁴ *mirabili varietate*.

alternation of summer and winter, even if it is barely perceived, since both the ring and the axis of the whole system are inclined by an angle of 31 [degree] with respect to the plane of the orbit of Saturn, [an angle] from which the globe is not supposed to decline much. But how long those summers and winters are—15 of our years. On the contrary, on Jupiter there is always the same climate of hot and cold for each region, and if the heat is greater or less than the cold, [it is] near the inhabitants of the equator rather than in the direction of the poles, to the point that the parts of the year there would be marked by nothing else but the rising of the stars. But now I return to the animals of these distant lands.

§14.

If, as is already evident enough, there are animals on the planets, both *provided of rationality*¹ and brutes, will they too increase themselves by means of *generation*?² At least, it can hardly be said that those that once were placed there remain perpetually the same. In fact, it would be necessary that in those lands there were neither the various calamities, nor ailments nor hateful wars or carnage, due to which the animals could die, and would not grow old. But perhaps their genus is renewed through some *very different rule*³ than here among us. It is reasonably possible. However, the *rule of our generations is so marvelous and divine*⁴ that one could hardly believe that it does not extend beyond this globe of ours. We also see that in such a great diversity of animals as we have, they are born from each other almost in the same way: not in one way in the regions of America and another in Africa, Europe, or Asia. And [we see] finally that all living beings are excited to generate from the *sense of pleasure*⁵; this *pleasure* far precedes all the others that are perceived by the *senses*⁶, and is it granted to the preservation of their genus not anymore than the same genus is created and preserved to enjoy this *pleasure*. Even those who are *capable of rationality*,⁷ do they not find, in fact, a great part of life and of all happiness in

¹ *ratione praedita.*

² *generatione.*

³ *alia ratione.*

⁴ *mirabilis ac divina est nostrarum generationum ratio.*

⁵ *voluptatis sensu.*

⁶ *sensu.*

⁷ *in ratione pollentibus.*

these things, those that concern love and the care of children? *Pleasure* is indeed the supreme and best gift of God, and consequently also the things in which it is placed should not be maintained to have been given only to the inhabitants of this Earth. I therefore believe that not only these *pleasures*¹ that we have in common with the beasts are granted to those inhabitants of the planets who are *provided of rationality*,² but also those of another kind, that derive from virtue and the contemplation of nature—since we have already given them *souls*³ that are capable of such things. Without *pleasure*, there would be *no [reason] why*⁴ life should be precious or desirable, neither to men nor to beasts. Let not the Stoics, nor any other sect of philosophers, contradict me here: in fact, if we appreciate correctly the universal opinion on the supreme good, no one suggests that *pleasure* is not a purpose; for some [the supreme good derives] from virtue and honor, for others not only from these but also from health, riches, and abundance of all enjoyable things, for others finally from those things that come as a reward after death, in comparison to which they despise all these human things. But in all cases there is the same purpose: *pleasure*. And here I cannot pass over in silence how greatly I wonder where the first idea of *pleasure* arose. Certainly, what is given to us as a small part of it derives from that eternal pleasure that always exist with God. How much must enjoy it He who bestows this [pleasure] to the animal kind and especially to men?

§15.

[*Later added in the margin:*] Will you be so arrogant as to explain what God has ordered in these distant heavenly spaces and bodies? I reply: I do not define nor assert anything with certainty, but I weigh *conjectures* and *verisimilitude*.⁵—But those can be given in a thousand ways you cannot imagine. I reply: this is precisely what will be examined. Here about sight. The appearance of celestial bodies. Food, fire, other sciences beyond geometry, music and astronomy, of which I have spoken, and which are their requirements.

¹ *voluptates.*

² *rationis participes.*

³ *animos.*

⁴ *non erat [ratio] cur.*

⁵ *conjecturas et verisimilitudinem.*

Furthermore, I believe that it can hardly be doubted that grasses, shrubs and trees are born on the surface of those planets or earths, not only for beauty, but for the animals to feed on them. But they will not be able to feed on them unless new ones are continually growing.

§16.

Therefore, given the knowledge and observation of heavenly things, how many other things must be conceded! In fact, there can be no observation of the stars without *instruments*¹, whether they are made of metal or wood, or some other solid material other than these, and this in turn requires the presence of the carpenters' saws, pick-axes and other tools of the same kind. Then also hands, or something that can perform the same function. But for these *instruments* [the knowledge of] the arcs of the circle and of the section of the arcs into equal parts is also required. It is also necessary to transmit to posterity the record of the observations and the ratios of times and epochs, which cannot apparently be performed without something written. Without consideration of the times, they can hardly exist.

Indeed, in order to develop an astronomic system from the observations of wandering stars and of the whole sky, this can be carried out, not differently than among us, *by imagining various conjectures and hypotheses*,² and not without the help of geometric theorems. They are indeed very far from being able to discern the distance of the celestial bodies by sight, since to them, not differently than for us, the stars seem partly to be affixed to the surface of a same sphere and be carried together, partly to wander. Besides, they could hardly be sure of the truth of the system unless it were possible to their eyes to distinguish the changing shapes and sizes of the planets according to the different exposure to the sun and the different distance between observers. Thus, either they have received a much sharper *sense of sight*³ than ours, or they will avail themselves of the help of lenses and mirrors not unlike our *telescopes*.

§17.

¹ *instrumentis.*

² *conjecturis ac hypothesisibus fingendis.*

³ *videndi sensum.*

What if they had not abandoned savageness and ignorance, like our Americans? When we look at them, does it not seem that God had the only purpose that men enjoy life, and the goods and pleasures of nature, while few aspire to the investigation of the sciences beyond nature? But this cannot be said. In fact, He foresaw that ingenious men would also appear for these things, to scan the skies, discover the arts useful for life, sail the seas, work metals. Could any of these things indeed happen beyond the intention of that great Author? Indeed, shall it not be said that He gave man the *use of rationality*¹ for such things? In fact, if [man] had been created only for this, to live and enjoy pleasures that even most beasts feel, why did He give man a mind so fit for arts and discovery? Why did He want him to know more than the brutes?

Hence, if he has foreseen these things, the nature of men also contains them, and the study of the arts and sciences cannot be considered outside of nature. But if they are here according to nature and by the favour of God, they will also exist in the other lands of the Planets according to the *same rule*.² And perhaps they will be even more perfect and abundant in those [Planets] that excel in greatness and companionship.

§18.

It seems somehow necessary that the inhabitants of the Planets be educated in all these things, if they enjoy the knowledge of celestial bodies as we do, as we have just shown to be *probable*.

However, one [aspect] not slightly contrasts with this, namely that among us inhabitants of the Earth there are so few scholars of astronomy and that not many more wish to learn those things that the accuracy of astronomers has brought to light. In the first place, Europe is the only one among the four parts of the world where this science is cultivated: in fact, no sane man will deny that that *divinatory astrology*,³ of which the peoples of Asia are everywhere raving, is worthless and should not be mentioned here. But in the countries of Europe not even one of a hundred thousand men understands or cares to know these things. Why then was the knowledge of these things given to so few if it is

¹ *rationis usum.*

² *eadem ratione.*

³ *astrologiam illam divinatricem.*

intended for mankind? Why also did it come so late, so many centuries having passed in which there was either no science of celestial things, or but a false one? In fact, 80 years have not yet passed since the real and simple motion of the planets was discovered by Kepler, having rejected the fictions of the epicycles. From this it may seem that the knowledge of celestial motions is not open to the contemplation of men who dwell here or on the planets, but that God has reserved it for himself, as worthy of his greatness.

However, since the *power of understanding*¹ and the skill necessary to prepare this investigation are granted to some men, albeit exceedingly few, it cannot be denied that this knowledge was also intended for mankind. This is not such a future event that God would not foresee. Moreover, it can be said that he did not want to impart these things to a few, although to only few in each century, if we consider the span of many centuries. Maybe we are still at the beginning, and with the passage of time the knowledge of these things will become much more frequent.

§19.²

Oh, what an *admirable spectacle*³ would appear to anyone who comes close to one of the planets. So far I have talked about them considering almost only those things similar to ours that, we may believe, exist on them. Now indeed if we pursue further what was assumed at the beginning, [namely] that these lands are adorned with no less variety [of things] than ours, and that among their inhabitants the discoveries, either for the convenience of life or for the *pleasure of the soul*,⁴ are not less numerous than ours nor inferior, how many things new to us we would see there. In fact, it cannot be doubted that many things we enjoy are lacking there. And since I have already concluded⁵ that these things are compensated by others, how many *admirable* things, never heeded by our reflection, will turn up in these regions? This will be best understood if we *imagine*⁶ that some inhabitant of Jupiter or Saturn has been brought

¹ *intelligendi vim.*

² Cf. *Insolitum spectaculum peregrino ex Jove advenienti* (OC, XXI).

³ *admirandum spectaculum.*

⁴ *animi oblectationem.*

⁵ Cf. §10 above.

⁶ *fingamus.*

to this Earth of ours by some spirit guide, or by Mercury, and we firmly establish that he will be impressed by the novelty of things without greater astonishment and *admiration*¹ than if any of us were led into the globes of these planets. Indeed, it seems right to draw attention to every single thing that appears to the traveller, so that we understand at the same time the multitude of our things, to which those present on the Planets are not deemed inferior. Even if, in fact, we have shown that in both places there are not a few common and similar things, it is nevertheless plausible that even in these many remain different enough that they can engage a curious spectator. How much diversity, in fact, already between American animals and plants and ours!



§20.

It seems to me that there are some universal elements. Just as water and rain to nourish the trees and grass, because on the one hand, this is established according to an *optimal rule*,² and on the other hand it seems that it could hardly have been otherwise. In fact, if they possessed some liquid element, but nothing was drawn upward from it by the Sun or by the intrinsic heat of the earth, as is the nature of our mercury, what nourishment would the shrubs that grow in slightly higher parts of these lands have? Or rather nothing would grow there, and so almost the whole earth would offer no food to the animals! Therefore, also trees and grasses can be considered as *something universal*,³ the kinds of which are many thousands, and yet with the same *organization*,⁴ firmly held by the roots, the filaments of which attract the moisture of the earth and let them grow by means of it alone.

¹ *admiratione.*

² *optime est ratio.*

³ *universale quid.*

⁴ *oeconomia.*

The multiplicity of the worlds, or of earths in the world, is a completely new dogma in Philosophy, which was finally discovered or confirmed in our century. In fact, among the ancient philosophers, at the time of Democritus and Philolaus,¹ there certainly was the suspicion but no certain truth, given that there were still *no astronomical rules*² ordering the System of the Planets around the Sun and proving this by the agreement of phenomena. This, indeed, was first demonstrated by Copernicus: but *thanks to the invention of the Telescopes*³ it became visible with the greatest evidence. From this point on, the whole *way of reasoning of Philosophy*⁴ was in some way changed, since only now we really know who and which particle of the universe we are. Undoubtedly, [we are] some small animals wandering on the surface of one of the globes that revolve around the Sun; undoubtedly, there are as many Suns of this type as the fixed stars, as we call them, that appear to us, and even as many as exist in the *immense spaces*.⁵ In fact, [it is] quite probable that we can see only very few out of their *unimaginable multiplicity*⁶. And [it is] even more probable that each such sun is accompanied by its earths. Since we think that we are such, we recognize to be something entirely different from what the majority of the ancient sages, to whom this Earth of ours seemed to be one of the two main parts of the world, the other being the heaven, deemed us to be. Even among those *provided with rationality*⁷ [it was thought] that some were gods and some men; to govern the latter was the principal occupation of these gods, or of the author of the world. How far below the evaluation of those [ancients] our new knowledge of the world places us. And at the same time how much intelligence elevates us above them, since we have been able to dispell this error. How much greater is the concept of God as the creator of so many and so various things, which he

¹ Cf. Section 2.

² *astronomicis rationibus.*

³ *Telescopiorum inventio.*

⁴ *Philosophiae ratio.*

⁵ *immensa spatia.*

⁶ *incomprehensibili multitudine.*

⁷ *ratione praeditorum.*

produced according to these *principles*¹ and art, so that, like *machines*² skillfully constructed, they could move of their own accord for any amount of time, and nothing would happen to them which he had not foreseen.

Instead, who could say that the whole work of God consists in these suns, earths, and moons, when in the infinite space he could have made innumerable other things, for imagining how they might be we cannot *find any rule*³? All the more, since it is more suited to *this immense and incomprehensible Nature*⁴ to operate many more things, and greater, than what our *intellectual weakness*⁵ could imagine.

§22.

Hence the beginning. There were serious and wise men who wandered into these meditations: Anaxagoras, Democritus, more recently Cardinal Cusano⁶ who believed that the planets and stars were inhabited, above all Plutarch, the important author of the book *De facie in orbe Lunae*.⁷

§23.

[*In the margin:*] What of the exactness of geometric discoveries, of logarithms, of the *miracles*⁸ of algebra. When I think of them, I can hardly convince myself that such things can be found among the inhabitants of Jupiter or Saturn, since these things are not known in our globe except in a few regions. But if they exceed us in capacity, why could they not have elicited both these and others more! Or if not the same, nevertheless different and better than ours. However, geometry is necessarily the same everywhere, and likewise the tones of the music!

¹ *legibus.*

² *machinae.*

³ *nulla ratione excogitare.*

⁴ *immensae et incomprehensibili isti Naturae.*

⁵ *imbecillitas.*

⁶ Cf. *Pensees meslees*, §45 and 55 (OC, XXI).

⁷ As mentioned in Section 2, cf. the letter No. LXXVIII (OC, XXII, 155).

⁸ *mirabilia.*



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“Mostri marini & terrestri, che si trovano in ogni luogo nelle parti d’aquilone” (Sea monsters & land monsters, found everywhere in the northern countries). Hand-colored map woodcut from Sebastian Münster’s *Cosmographia universale*, 1575. Courtesy of Götzfried Antique Maps, <https://www.vintage-maps.com>.