Copernican Revolutions Revisited in Adam Smith by way of David Hume

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This paper revisits Adam Smith's treatment of Copernicanism and Newtonianism in his essay "The History of Astronomy". I will provide a detailed analysis of all the comments that Smith makes on the Hume's oeuvre, noting their concordances and differences. The latter due to two conflicting commitments: i) Hume is committed to the "true philosophy" –a certain kind of scepticism which Smith does not share; ii) Hume never seems to have assimilated the way Newton changed the evidential standards within science.

Keywords: *Hume, Adam Smith, History of the Philosophy of Science, Copernicanism, Scientific Revolutions.*

En este artículo se vuelve a revisar el tratamiento que hace Smith en la Historia de la Astronomía, sobre el copernicanismo y el newtonismo. Para ello se ofrece un detallado análisis de las observaciones que Smith hace a la obra de Hume, señalando sus concordancias y diferencias. Estas últimas se deben a dos compromisos en conflicto: i) Hume se ha comprometido con la filosofía "verdadera" –un cierto tipo de escepticismo que Smith no comparte, ii) Hume no parece haber asimilado la forma en que Newton cambió los criterios de evidencia dentro de la ciencia.

Palabras clave: *Hume, Adam Smith, Historia de la Filosofía de la Ciencia, Copernicanismo, Revoluciones científicas.*

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In this paper I revisit[1] Adam Smith's treatment of Copernicanism and Newtonianism in his essay, "The History of Astronomy" (hereafter: "Astronomy"), in light of a surprisingly ignored context: David Hume. This remark will strike most scholars of Adam Smith as unfounded –David Hume's philosophy is often invoked as a source of Smith's approach in the "Astronomy"[2] or as its target[3]. Yet, Hume's occasional remarks on Copernicanism nor his treatment of the history of science in the History of England (1754-62, but revised throughout Hume's life) have not been carefully analyzed in light of the "Astronomy"[4].

In the first five sections of this paper I offer a detailed analysis of all of Hume's remarks on the Copernican system in his oeuvre. I show that David Hume believed that Copernicus achieved a "revolution" in philosophy. Moreover, I argue that Hume increasingly treats Galileo as the hero of the Copernican revolution. In doing so, Hume appears surprisingly blind to the importance of post-Galilean natural philosophy, especially the (dynamical) arguments that

1 Schliesser, E. (2005b).

2 The editors of the Glasgow edition write, "Although it does not mention Hume by name, ["Astronomy"] shows unmistakable signs of influence from the *Treatise of Human Nature*. Apart from Humean language about the association of ideas and about degrees of vivacity in sensations, Smith's account of the imagination seems to be an adaptation of *Hume*. He does not simply follow *Hume*, however, as he largely followed Berkeley when writing of vision in the essay on the External Senses. His view of the imagination in the History of Astronomy adds a significant element of originality by applying to the hypotheses of science a notion which *Hume* had used to explain the beliefs of common sense". EPS V. 1. For recent treatment see Montes, L. (2008).

3 See Schliesser, E. (2005a) and Schliesser, E. (2006).

4 Hume certainly knew of the "Astronomy" because in a letter dated 16 April 1773, Smith informs him of its existence. In this essay I remain agnostic about to what degree Smith may have influenced Hume.

Huygens and Newton provided for the rotation of the Earth. In the last section of the paper, I argue that Adam Smith does show appreciation of dynamic views. I show that Smith and the mature Hume agree on the importance of Galileo, even describing his method in strikingly similar language, but that they evaluate the evidence differently in light of two conflicting commitments: i) Hume is committed to the "true philosophy" –a certain kind of scepticism which Smith does not share; ii) Hume never seems to have assimilated the way Newton changed the evidential standards within science.

I. Hume and the Copernican system

1. The Copernican Revolution in *Treatise* 2.1.3

Hume discusses the Copernican hypothesis on at least five occasions in his writings: once in *A Treatise of Human Nature* (2.1.3; hereafter *Treatise*), once in the *Enquiry Concerning Human Understanding Enquiry* (EHU 12.2.23), once in his essay, "The Skeptic", once in the *History of England*, and once in the *Dialogues Concerning Natural Religion* (*Dialogues*).

In the *Treatise* and in "The Skeptic", Copernicanism gets introduced as a model to be emulated for or aspirations within "moral philosophy." In both cases this is not the whole point of the treatment of Copernicanism. I quote and discuss the *Treatise* first:

"Besides, we find in the course of nature, that tho' the effects be many, the principles, from which they arise, are commonly but few and simple, and that 'tis the sign of an unskillful naturalist to have recourse to a different quality, in order to explain every different operation. How much more must this be true with regard to the human mind, which being so confin'd a subject may justly be thought incapable of containing such a monstrous heap of principles, as woul'd be necessary to excite the passions of pride and humi-

lity, were each distinct cause adapted to the passion by a distinct set of principles?

Here, therefore, moral philosophy is in the same condition as natural, with regard to astronomy before the time of *Copernicus.* The antients, tho' sensible of that maxim, *that nature does nothing in vain,* contriv'd such intricate systems of the heavens, as seem'd inconsistent with true philosophy, and gave place at last to something more simple and natural. To invent without scruple a new principle to every new phænomenon, instead of adapting it to the old; to overload our hypotheses with a variety of this kind; are certain proofs, that none of these principles is the just one, and that we only desire, by a number of falsehoods, to cover our ignorance of the truth" (*Treatise* 2.1.3).

I have five observations on this passage. First, Hume treats the Copernican system as a methodological improvement over the systems inherited from the "antients" because it provides a nice example of explanatory reductionism; different visible effects can be accounted for by the same simple principle–it is in this sense that a scientific theory can be "simple and natural" to Hume.

Second the improvement is not merely one of degree, but *discontinuous*. Pre-Copernican theory is neither "simple", nor "natural", and inconsistent with "true philosophy"; Copernican theory is "simple", "natural", and at least compatible with "true philosophy". Leaving aside what these terms mean, Hume is claiming that a revolution in thought has taken place. So, while Hume does not use the phrase "revolution" here, he certainly has the concept in mind. This is not as far-fetched as it sounds. In a letter to Henry Home, 13 February 1739 (just after the first two volumes of the *Treatise* had appeared), Hume uses "total alteration in philosophy" and "revolutions of this kind" synonymously –in context he is describing his aims for his philosophy (to produce a total alteration) and lamenting the poor reception of the *Treatise*. So, Hume diagnoses intellectual revolutions in history and is eager to introduce one himself. While the

occurrence of intellectual revolutions even within astronomy is a skeptical trope[5], Hume does not seem deploy it only in skeptical manner here. As is well known Smith's "Astronomy" is constructed around a psychological and historical analysis of such successive even Kuhnian "revolutions"[6].

Third, for Hume the pre-Copernican theory was simply "inconsistent with true philosophy". In this context Hume appears to be using "true philosophy" in a methodological sense; if every phenomenon receives its own explanation one is simply on the wrong track[7]. Of course, "true philosophy" can have a second, wider meaning: it may also mean not only that one is on the correct methodological track, but also uncovering the way nature is.

2. Digression: True Philosophers

In order to understand the phrase, "true philosophy"[8], I digress briefly to a passage earlier in the *Treatise* just after Hume gives an introduction to the associative mechanism (the principle that as he describes in the "Abstract" gives the "author to so glorious name as that of an inventor"). Here there is some helpful material to understand the phrase "true philosophy" and the relationship between natural and moral philosophy:

"These are therefore the principles of union or cohesion among our simple ideas, and in the imagination supply the place of that inseparable connexion, by which they are united in our memory. Here is a kind of ATTRACTION, which in the mental world will be found

5 See Montaigne, M. de (1988).

6 For detailed references see Schliesser, E. (2005a).

7 Here I ignore to what degree Hume's treatment of pre-Copernican astronomy is fair; presumably he has in mind the oft-caricatured tendency to introduce, say, new epicycles in order to 'save' the phenomena in Ptolemaic astronomy.

8 The classic work on this topic is Livingston, D.W. (1988).

to have as extraordinary effects as in the natural, and to shew itself in as many and as various forms. Its effects are every where conspicuous; but as to its causes, they are mostly unknown, and must be resolved into original qualities of human nature, which I pretend not to explain. Nothing is more requisite for a true philosopher, than to restrain the intemperate desire of searching into causes, and having established any doctrine upon a sufficient number of experiments, rest contented with that, when he sees a farther examination would lead him into obscure and uncertain speculations. In that case his enquiry would be much better employed in examining the effects than the causes of his principle" (1.1.4.6).

Hume's associative principle is a kind of mental attraction evidentially on par with the physical kind[9]. It provides, as Hume claims in the "Abstract", an explanatory reductionism. Hume suggests it is no less successful an explanation as Newtonian attraction. In the Introduction to *Treatise* Hume had claimed that "we may hope to establish on [judiciously collected experiments and cautious observations of human life] a science, which will not be inferior in certainty, and will be much superior in utility to any other of human comprehension" (*Treatise*, Intro 10). Leaving aside questions of utility, at *Treatise* 1.1.4.6 Hume claims that in providing the principles of cohesion among our simplies ideas he has delivered on the first part of the Introduction's promissory note.

Nevertheless, 1.1.4.6 gives a sceptical slant to this achievement –the causes of the principle of association must be unaccountably located in the "original qualities of human nature"[10]. Crucially, Hume identifies the "true philosopher" with the person who knows how to stop

9 Hume sticks with this claim (see Hume's essays "Of the Balance of Trade" and "Dissertation of the Passions").

10 In two papers, Schliesser, E. (under review) and Schliesser, E. (2010a), I explore how Adam Smith offers very Humean account of the origins of original qualities of human nature.

further enquiry. Putting an end to enquiry into causes avoids getting one involved in the wrong (obscure and uncertain) kind of enterprise –the sort that only leads to *useless* speculations (these are treated as objects of "pure curiosity" (*Treatise,* Introduction, 5). While on the surface Hume's argument is very akin to Newton's '*hypotheses non fingo*', Newton did not think one ought to end inquiry. Rather he hoped that "the principles set down here will shed some light on either this mode of philosophizing *or some truer one*" (*Principia*, Author's Introduction, emphasis added; see also Newton's fourth rule of reasoning)[11]. While not denying that Hume is advocating further research on the effects of a known principle, the Humean "true philosopher" of the *Treatise* respects certain kinds of self-imposed limits to inquiry. The criterion seems to be provided by to what degree we are led to objects of pure speculation which follows from inquiry that may not have determinate result. So, if we allow that "true philosophers" operate by/with "true philosophy", one can treat Hume's "true philosophy" methodologically. It is committed to explanatory reductionism and it will limit further attempts at explanation within carefully confined boundaries. For now, I assume that the "true philosophy" can be agnostic about the epistemic status of the content of a theory.

3. The Copernican Hypothesis in *Treatise* 2.1.3&EHU 1

I return to *Treatise* 2.1.3 in order to make a fourth point. In *Treatise* 2.1.3 Hume uses the Copernican model to criticize previous attempts within the science of man, which are in a 'pre-Copernican' state. *Treatise* 1.1.4.6 asserts Hume's 'Copernican' breakthrough.

Fifth, as should be clear from all of this, Hume treats the Copernican explanatory reduction as a (revolutionary) model to be

11 For a larger argument, see Schliesser, E. (2010b).

emulated within moral philosophy[12]. This strategy is echoed with a twist in the first *Enquiry*: "Astronomers had long contented themselves with proving, from the *phaenomena*, the true motions, order, and magnitude of the heavenly bodies: till a philosopher, at last, arose, who seems, from the happiest reasoning, to have also determined the laws and forces, by which the revolutions of the planets are governed and directed. The like has been performed with regard to other parts of nature. And there is no reason to despair of equal success in our enquiries concerning the mental powers and economy, if prosecuted with equal capacity and caution" (EHU 1.15). Rather than using Copernicus as the source of emulation Newton is the alluded to exemplar for the science of man.

In the first *Enquiry* Hume is clearly aware that Newton went well beyond prior astronomical explanations: pre-Newtonian astronomical explanations concerned "true motions, order and magnitude of the heavenly bodies", while Newton's explanations involve these and in addition include the laws and forces. (For the sake of argument/brevity: Hume is pretending to be or is unaware of instrumentalism in astronomy.) The natural way to read this is that Hume thought that pre-Newtonian astronomy could legitimately claim to determine true motions. The question is, however, how in the absence of the (dynamical) explanatory framework of forces and laws pre-Newtonian astronomers could have thought they were describing true motions, rather than merely relative motions. There is no sign here that Hume is aware of the question.

A passage near the end of the first *Enquiry* raises some related complications. Hume writes that "A Copernican or Ptolemaic, who

12 In *Treatise* 2.1.3 Hume deploys a curious if not opportunistic argument to bolster the strategy: given that the mind occupies but a small space, there cannot be many causes. This is not the place to examine how this argument fits in with other Humean commitments.

supports each his different system of astronomy, may hope to produce a conviction, which will remain constant and durable, with his audience" (EHU 12.2.23). In context this conviction producing quality is contrasted with the instability that "excessive scepticism" causes in the minds of its audience. So, on Hume's reading pre-Newtonian astronomers were capable of settling debates about their subject matter (including "true motions"). Hume's claim is historically accurate. It also lays the seeds toward a social understanding of astronomy of the sort that Smith engages in the Astronomy. But recall that by Hume's light's the Ptolemaic system is neither natural nor simple (assuming he has not changed his mind about this). So, by Hume's lights the community of experts can ignore in practice what Hume thinks of as "certain proofs", of falsity and endorse massively un-explanatory systems! This is again a striking anticipation of Smith's "Astronomy"[13]. But then why think that pre-Newtonian *Copernican* astronomy was in an evidential position to avoid making a similar mistake? Why think that reductionism, naturalness, and simplicity are truth tracking?

In the next section I explore Hume's comments on beauty and simplicity as they pertain to Copernicanism and astronomy. Here I conclude this first section, by summarizing some of the highlights. In this section we showed that Hume thinks of Copernican theory as providing a revolution (understood as a discontinue break) in science. Hume's analysis of it is not relativistic; he thinks of Copernican theory as an improvement because it provides explanatory reductionism. This achievement fits nicely with Hume's understanding of "true philosophy", which is committed to such explanatory reductionism while limiting further attempts at explanation within carefully confined boundaries. Moreover, Hume is clearly aware that Newton successfully introduced conceptual apparatus into natural philo-

13 For detailed references see Schliesser, E. (2005a).

sophy that goes beyond what is available to Copernicus. What is left entirely unclear is how Hume is thinking about astronomy's ability to establish "true motions" prior to Newton. Along the way, I have called attention to what I take to be uncontroversial Humean anticipations of Smith's "Astronomy". Smith developed the language of revolutions, focusing on the importance of aesthetic criteria and what we would call social epistemology.

II. Hume on beauty, simplicity, and uniformity

In a recent unpublished paper, Silvia Manzo argues that Hume endorses the Copernican theory because it is simple, beautiful, and uniform[14]. Let me grant from the start that Hume thinks there is "natural" beauty and that the concepts of geometric and astronomical theories can be evaluated in terms of it (see, for example, Appendix 1.14 of EPM). To be sure, beauty is not a quality of, say, a circle itself, but of "the effect, which that figure produces upon the mind". But that causes no special problems here. There are two open questions: 1) does Hume find Copernican theory beautiful? 2) Is Hume inclined to infer the truth of a system from its beauty?

The only evidence that Manzo can cite for the claim that Hume finds the Copernican theory beautiful comes from "The Skeptic". I discuss that passage below. But given that it is by no means obvious that we should identify Hume's views with those expressed in that essay, it is insufficient basis to adscribe the claim to Hume. As far as the second question is concerned, I am unfamiliar with a passage in which Hume endorses the inference from the ascription of beauty to the truth when speaking of matters of fact.

Second, *Treatise* 2.1.3 provides as we have seen good evidence that Hume thought the Copernican system was simple and natural.

14 Manzo, S. (2009).

Manzo nicely points out that the simplicity of the Copernican system accords with Hume's fourth rules of reasoning (*Treatise* 1.3.15.6)[15]. But having granted this, I would be cautious in adscribing to Hume a general principle that allows inference of simplicity to truth when speaking of matters of fact. The reason for this is straightforward. No doubt many incompatible astronomical theories can be beautiful, but that cannot be sufficient for truth. (Example: are within Copernicanism circular or elliptical orbits more beautiful?).

Third, by uniformity, Manzo means something like, 'accords with proper analogical reasoning'. I agree with her important claim that one can derive from Hume's Rules of Reasoning an analysis of proper use of analogy. But she can only point to some of Philo's remarks in the *Dialogues* for evidence that Hume thought about Copernicus in this way. Again, it is extremely uncertain we should simply identify Hume with any of the speakers of the *Dialogues* . I return to the *Dialogues* below. But first I look at a celebrated passage in "The Skeptic".

III. The Skeptic

Hume treats of Copernicanism in "The Skeptic" in a striking paragraph:

"In the operation of reasoning, the mind does nothing but run over its objects, as they are supposed to stand in reality, without adding

15 "The same cause always produces the same effect, and the same effect never arises but from the same cause. This Principle we derive from experience, and it is the source of most of our philosophical reasonings. For when by any clear experiment we have discovered the causes or effects of any phaenomenon, we inmediately extend our observation to every phenomenon of the same kind, without waiting for that constant repetition, from which the first idea of this relation is derived".

any thing to them, or diminishing any thing from them. If I examine the PTOLOMAIC and COPERNICAN systems, I endeavour only, by my enquiries, to know the real situation of the planets; that is in other words, I endeavour to give them, in my conception, the same relations, that they bear towards each other in the heavens. To this operation of the mind, therefore, there seems to be always a real, though often an unknown standard, in the nature of things; nor is truth or falsehood variable by the various apprehensions of mankind. Though all human race should for ever conclude, that the sun moves, and the earth remains at rest, the sun stirs not an inch from his place for all these reasonings; and such conclusions are eternally false and erroneous".

First, the paragraph is not a bald claim on behalf of Copernicanism. Rather it is a claim about the natural operation of the (well trained) mind in a certain domain (that is of "truth and falsehood" in which the "apprehensions of mankind" are irrelevant). Now despite this context and the conditional nature of the passage ("If I examine"), one still may be tempted to see in the concluding lines of the passage a clear affirmation of Copernicanism. But it, too, *can* be read conditionally ("Though…should").

Second, it is by no means obvious that we should read "The Skeptic" as Hume's own position. Whatever else one may think of "The Skeptic", old-Hume style scepticism (think of *melancholy, delirium, despair, human maladies,* etc.) is never even raised as a *possibility*. This is no surprise if old-Hume style scepticism does not *naturally* occur in the world. Recall Hume's footnote at the start of the four relevant essays: "The intention of this and the three following essays is not so much to explain accurately the sentiments of the ancient sects of philosophy, as to deliver the sentiments of sects, that naturally form themselves in the world, and entertain different ideas of human life and of happiness". So, we should not read "The Skeptic" as evidence for Hume's own scepticism, but rather as evidence for a natural form of scepticism.

Third, while the "Skeptic" affirms the existence of "a real, though often an unknown standard, in the nature of things", his (her?) claim about what astronomical theories can achieve is quite modest. The "real situation of the planets" turn out to be no more than "the same relations, that they bear towards each other in the heavens" –these theories give relative positions only. If the "Skeptic" were to speak for Hume this would be in accord with his instrumentalism about science more generally[16], but at odds with EHU 1.15.

Fourth, leaving aside hermeneutic problems, if this is Hume speaking in his own voice it is reason for concern about Hume's understanding of the state of play post Newton. In proposition XII, Theorem XII of Book III of the *Principia*, Newton had shown that the "sun itself is moved" (albeit "not very far from") the common (immovable) center of gravity of the solar system (which is taken as "the center of the world")[17]. So, if we adscribe the view presented in "the Skeptic" ("the sun stirs not an inch from his place") to Hume we saddle him with a blunder. But I see no compelling reason why we should adscribe the views expressed in the essay to Hume. Similar interpretive problems surround the *Dialogues*, to which I turn next, but the treatment of Copernicanism is instructive nevertheless.

IV. The *Dialogues*

The Copernican system is treated three times in the *Dialogues*. The first instance is the most extensive; Cleanthes uses it to attack the (very Humean) distinction between provable common life and distant speculations:

16 Schliesser, E. (2008). Accessed 12 November 2009.

17 I have used an online version of Andrew Motte's translation, accessed on July 8, 2009: http://www.archive.org/stream/newtonspmathema00newtrich#page/n7/mode/2up.

"In reality, would not a man be ridiculous, who pretended to reject Newton's explication of the wonderful phenomenon of the rainbow, because that explication gives a minute anatomy of the rays of light; a subject, forsooth, too refined for human comprehension? And what would you say to one, who, having nothing particular to object to the arguments of Copernicus and Galileo for the motion of the earth, should withhold his assent, on that general principle, that these subjects were too magnificent and remote to be explained by the narrow and fallacious reason of mankind? […] the refined and philosophical sceptics fall into an inconsistence of an opposite nature. They push their researches into the most abstruse corners of science; and their assent attends them in every step, proportioned to the evidence which they meet with. They are even obliged to acknowledge, that the most abstruse and remote objects are those which are best explained by philosophy. Light is in reality anatomized. The true system of the heavenly bodies is discovered and ascertained. But the nourishment of bodies by food is still an inexplicable mystery. The cohesion of the parts of matter is still incomprehensible. […] In vain would the sceptic make a distinction between science and common life, or between one science and another. The arguments employed in all, if just, are of a similar nature, and contain the same force and evidence. Or if there be any difference among them, the advantage lies entirely on the side of theology and natural religion. Many principles of mechanics are founded on very abstruse reasoning; yet no man who has any pretensions to science, even no speculative sceptic, pretends to entertain the least doubt with regard to them. The Copernican system contains the most surprising paradox, and the most contrary to our natural conceptions, to appearances, and to our very senses: yet even monks and inquisitors are now constrained to withdraw their opposition to it?" (*Dialogues* 1, 137-8)[18].

18 Page-numbers refer to the Kemp-Smith edition of the *Dialogues*, accessed from: http://www.anselm.edu/homepage/dbanach/dnr.htm, 11 November, 2009.

Here I avoid exploring how we should evaluate Cleanthes' claims in light of Hume's philosophy. First, Cleanthes' claim is peculiar because while he mentions Newton's treatment of the rainbow, he is entirely silent about Newton's treatment of Copernicanism. Rather, he strictly limits himself to mentioning Copernicus' and Galileo's arguments for the motion of the earth. Cleanthes seems to think that post-Galileo Copernicanism is a settled fact. This is contrasted with the "mystery" surrounding "the nourishment of bodies by food". Cleanthes' claim is that no skeptic, who at least *pretends* to be *informed*, oughts seriously willing to doubt the results of natural philosophy. Either Hume is signaling (perhaps unintentionally) that he never read Newton's treatment of Copernicus, or he is mischievously showing that Cleanthes' is not as sophisticated as most readers take him to be. I prefer the latter explanation because we have seen that Hume is aware that Newton changed the nature of explanation in astronomy (recall treatment of first *Enquiry* above).

Second, whatever else one can say about Copernicanism, by Cleanthes' lights there was nothing "natural" about it-it "contains the most surprising paradox". So, explanatory reductionism is often a hard-won achievement.

In context Philo does not engage with Copernicanism. But a bit later when Cleanthes attempts to employ analogical argument Cleanthes and Philo have a heated exchange in which Philo explains how he understands the status of Copernicanism:

"[Cleanthes:] And a caviller might raise all the same objections to the Copernican system, which you have urged against my reasonings. Have you other earths, might he say, which you have seen to move? Have…

Yes! cried Philo, interrupting him, we have other earths. Is not the moon another earth, which we see to turn round its centre? Is not Venus another earth, where we observe the same phenomenon? Are not the revolutions of the sun also a confirmation, from analogy, of

the same theory? All the planets, are they not earths, which revolve about the sun? Are not the satellites moons, which move round Jupiter and Saturn, and along with these primary planets round the sun?". These analogies and resemblances, with others which I have not mentioned, are the sole proofs of the Copernican system; and to you it belongs to consider, whether you have any analogies of the same kind to support your theory.

In reality, Cleanthes, continued he, the modern system of astronomy is now so much received by all enquirers, and has become so essential a part even of our earliest education, that we are not commonly very scrupulous in examining the reasons upon which it is founded. It is now become a matter of mere curiosity to study the first writers on that subject, who had the full force of prejudice to encounter, and were obliged to turn their arguments on every side in order to render them popular and convincing. But if we peruse Galileo's famous *Dialogues* concerning the system of the world, we shall find, that that great genius, one of the sublimest that ever existed, first bent all his endeavours to prove, that there was no foundation for the distinction commonly made between elementary and celestial substances. The schools, proceeding from the illusions of sense, had carried this distinction very far; and had established the latter substances to be ingenerable, incorruptible, unalterable, impassible; and had assigned all the opposite qualities to the former. But Galileo, beginning with the moon, proved its similarity in every particular to the earth; its convex figure, its natural darkness when not illuminated, its density, its distinction into solid and liquid, the variations of its phases, the mutual illuminations of the earth and moon, their mutual eclipses, the inequalities of the lunar surface, etc. After many instances of this kind, with regard to all the planets, men plainly saw that these bodies became proper objects of experience; and that the similarity of their nature enabled us to extend the same

arguments and phenomena from one to the other" (*Dialogues* Part 2, 150-1).

Philo and Cleanthes *agree* that the positive argument on behalf of Copernicanism is *strictly* analogical. These arguments go beyond *mere* analogy, because there are converging arguments for the claim that the Earth is one planet among others. The analogical evidence is, thus, robust; this is why these arguments provide "proofs". "Proof" is the highest epistemic category for matters of fact in Hume's system (see, especially, the footnote at the start of EHU 6; It falls a bit short of demonstrable certainty, but that is unattainable for factual matters.) These are said to offer "confirmation" of Copernican theory. Philo is careful, however, not to claim that these provide a "full proof" (the highest form of certainty in matters of fact; for this locution, see e.g., *Dialogues* Part 9, 188).

Silvia Manzo has nicely shown that Hume almost certainly consulted Galileo's *Dialogues* in composing this passage[19]. Philo points out that if one wishes to understand theory acceptance one often finds the most detailed arguments in favor of a doctrine in the theory's early days because they have to overcome steady opposition if not downright skepticism. Philo is clearly charmed by Galileo, who he

19 There are some differences between Salviati and Philo, however. Where Salviati blames "Aristotle" for the distinction between "celestial and elementary…parts," Philo blames "the schools" for the distinction between "elementary and celestial…substances". Besides a subtle shift in culprits, note the reversal of order and the move from parts to substances. A more important difference is that Philo attributes the origin of the schools' mistake to "the illusions of sense" whereas Salviati attributes Aristotle's mistake to the "diversity of local motions". This difference is not a mere rhetorical or stylistic flourish, but a change in content. While Salviati and Philo are both offering an error-theory, Salviati explains that the error is due to the complex nature of the phenomena; Philo is making a sceptical point. For Salviati the moon and the earth only agree "in some things", while for Philo they agree "in every particular".

calls "one of the sublimest" geniuses that ever existed[20]. No doubt Philo (and Hume) also finds Galileo's anti-clericalism and anti-authoritarianism appealing. Because Philo (and Cleanthes does not demur) also claims Galileo's analogical arguments are the "sole" proofs for Copernicanism, he also appears unaware of the fact that post Huygens and Newton qualitatively different kind of evidence emerged for Copernicanism. In the *Dialogues*, the engagement with Copernicanism is entirely pre-Newtonian in character.

It is a bit unclear how to take Philo's arguments in part 2 of *Dialogues*. The status of analogical argument comes under fire throughout the remainder of the *Dialogues*, but without touching on Copernicanism. Philo returns to the status of Copernicanism in the last, twelfth part of the *Dialogues* in a passage that is notorious because it seems to reflect Philo's concession to the argument from design. He says:

"A purpose, an intention, a design, strikes every where the most careless, the most stupid thinker; and no man can be so hardened in absurd systems, as at all times to reject it. That Nature does nothing in vain, is a maxim established in all the schools, merely from the contemplation of the works of Nature, without any religious purpose; and, from a firm conviction of its truth, an anatomist, who had observed a new organ or canal, would never be satisfied till he had also discovered its use and intention. One great foundation of the Copernican system is the maxim, that Nature acts by the simplest methods, and chooses the most proper means to any end; and astro-

20 This fits with other evidence from Hume: if we ignore contribution to public utility altogether, Galileo would merit highest esteem ("Of the Middle Station of Life". EMPL 550). It is a bit strange that Hume is so unwilling to acknowledge "virtue and usefulness to the public" of Galileo (whose work was intended to be applied to the calculating proper trajectories of cannonballs and finding longitude at sea not to mention the important work on strength of materials -it seems Hume did not read Galileo's *Two New Sciences*!) or Newton (who even served in the Mint).

nomers often, without thinking of it, lay this strong foundation of piety and religion. The same thing is observable in other parts of philosophy: and thus all the sciences almost lead us insensibly to acknowledge a first intelligent Author; and their authority is often so much the greater, as they do not directly profess that intention" (*Dialogues* part 12, 214).

If we leave aside his commitment to a "first intelligent Author". Philo seems to be endorsing simplicity as a feature of nature and Copernicanism. No doubt this illuminates why explanatory reductionism is an attractive strategy. So, a fruitful way to read Philo in the *Dialogues* is to see his acceptance of Copernicanism turn on analogical arguments that provide explanatory reductionism (not to mention that Galileo has successfully criticized the rivals of Copernicanism). But it is by no means clear that Philo is also offering an endorsement of Copernicanism in part 12. For the passage above is provided in context of an error theory; the context explains why "all the sciences" including ones –Galenism!– rejected by Philo that "lead us insensibly to acknowledge a first intelligent author". This is compatible with the claim that Copernianism is an obvious improvement over Ptolemaic system without requiring an endorsement of it.

However, the treatment of Copernicanism and Galileo is echoed in *The History of England*, and there can be no doubt that Hume is speaking in his own voice there. So, I examine these in my conclusion of this survey of Humean engagement with Copernicanism.

V. Copernicanism in Hume's *The History of England*[21]

In the "Appendix" to the section on King James 1 Hume offers a summary of the life of Bacon in which Galileo and Copernicanism play a central role:

21 For an excellent introduction to Hume's historiography of science, see Wertz, S.K. (1993).

"The great glory of literature in this island, during the reign of James, was lord Bacon […] is justly the object of great admiration. If we consider him merely as an author and philosopher, the light in which we view him at present, though very estimable, he was yet inferior to his comtemporary Galileo, perhaps even to Kepler. Bacon pointed out at a distance the road to true philosophy: Galileo both pointed it out to others, and made himself considerable advances in it. The Englishman was ignorant of geometry: The Florentine revived that science, excelled in it, and was the first that applied it, together with experiment, to natural philosophy. The former rejected, with the most positive disdain, the system of Copernicus: The latter fortified it with new proofs, derived both from reason and the senses. [...] Galileo is a lively and agreeable, though somewhat a prolix writer. But Italy, not united in any single government, and perhaps satiated with that literary glory, which it has possessed both in ancient and modern times, has too much neglected the renown which it has acquired by giving birth to so great a man. That national spirit, which prevails among the English, and which forms their great happiness, is the cause why they bestow on all their eminent writers, and on Bacon among the rest, such praises and acclamations, as may often appear partial and excessive"[22].

First, Galileo is introduced as a yardstick by which admiration of Bacon is diminished. Hume continues to admire Bacon, but Hume clearly does not portray Bacon as the re-founder of the sciences or a particularly important philosopher (as he had in the Introduction to the *Treatise*). In fact, he comes very close to claiming that the praise for Bacon has its roots in English nationalism. If anything, he suggests that literary fame can be a consequence of the vicissitudes

22 *History* Vol. 5. Chapter: *APPENDIX TO THE REIGN OF JAMES I* *Accessed from http://oll.libertyfund.org/title/792/67338/1648595 on 2009-09-27.

of national unity[23]. Hume's perspective here is quite European: he calls attention to the contributions of Copernicus, Kepler, and Galileo. Hume's admiration of Galileo dates back to "Of the Middle Station of Life", which first appeared in 1742 (and was later withdrawn).

Second, Hume's narrative of the progress of philosophy, from "the dark period of the thirteenth century"[24] and "the most inconsiderable progress" during the reformation onward[25], gathers speed[26]. Bacon's role in it is much reduced: he "pointed out at a distance the road to true philosophy". Bacon is not a true philosopher; he never even made it on the road to true philosophy. Bacon is a sign-post for things to come; that is all. While the description of Kepler is terse, Hume seems to imply that Kepler made it on the road to true philosophy. But the new hero of the narrative is Galileo, who not only spread the good news, but made "considerable advances" toward "true philosophy". But Galileo, is not labelled as a "true philosopher"; he has only made considerable advances on the road; even Boyle and Newton, who make even more progress on it, are never said to *complete* the road to true philosophy[27].

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23 Hume's treatment of Hobbes in the *History* ("in our time, he is much neglected: A lively instance how precarious all reputations, founded on reasoning and philosophy!") and his treatment of Locke's (who will be "entirely forgotten" when people may still be reading Addison (*first Enquiry*), suggests that posthumous fame of the philosopher is never far removed of his thoughts. For more on the significance of this, see Schliesser, E. (2003).

24 *History,* Vol. 2. Chapter: *XII: HENRY III.* Accessed from http://oll.libertyfund.org/title/789/67278/1643391 on 2009-09-27.

25 *History* Vol. 3. Chapter: *XXIX;* Accessed from http://oll.libertyfund.org/title/790/67311/1645566 on 2009-09-27.

26 For more on these themes see Schmidt, C.M. (2003), and Schliesser, E. (ms).

27 Schliesser, E. (2008).

Third, the passage leaves no room for doubt that Bacon's opposition to Copernicanism and his ignorance of geometry are reasons for censure[28]. Kepler, who is barely mentioned, and Galileo share advocacy of Copernicanism and possess amble geometrical skills.

Fourth, if we leave aside Galileo's writing style, Hume commends him for his methodology of "reason and the senses". In context, it is clear that Hume is pointing to Galileo's use of mathematics and its interplay with experiment/observation in natural philosophy. It is a significant passage because it is one of the very few places where Hume shows recognition of the important role of mathematics within natural philosophy[29].

Fifth, Hume is explicit that Galileo "fortified" the "system of Copernicus" with "new proofs". Hume now makes a distinction between the evidence for Copernicus as marshaled by Copernicus and the new arguments that Galileo supplied. In ways unremarked upon in the *Treatise* or elsewhere Hume finally seems aware that for Copernicus' explanatory reductionism to succeed it required Galilean arguments of diverse kind.

Thus, sixth, Hume's treatment of Copernicanism does not simply echo Philo's argument in the *Dialogues*. Besides Hume's willingness to distinguish between Copernicus and Galileo, there are two other differences: i) in his own voice Hume is silent on the analogical and aesthetic arguments that are said to support Copernicanism in *Dialogues* ; the passage above is compatible with these, of course. ii) Hume's awareness of the interplay of mathematics and experi-

28 For a judicious treatment of Bacon's opposition to Ptolemy and Copernicus see Gaukroger, S. (2001), especially chapter 6.

29 Graciela de Pierris has even claimed about Hume that "in his adoption of Newtonian inductive method, Hume ignores the role of mathematics and idealizations". See de Pierris, G. (2006), p. 320.

ment/observation is the most sophisticated observation he makes about the practice of the new, post-Galilean natural philosophy.

Finally, even in the *History of England*, Hume does not assert that there is a full proof for Copernicanism. Unfortunately, when in the final volume of the *History* Hume discusses Newton he does not return to the question of the status of Copernicus.

VI. First Concluding Remarks on Hume

Hume's most sophisticated engagement with the Copernicus revolution occurs in his own voice (in the *Treatise*, first *Enquiry*, and the *History of England*). Copernicanism is his model for explanatory reductionism, especially because it has certain virtues (simplicity, beauty, etc) associated with it. In the *History*, especially, Hume leaves no doubt that opposition to Copernicanism is by no means admirable. Through the course of his life Hume became progressively more aware and outspoken about Galileo's contribution to developing evidence in favor of Copernicanism. But while he seems to have been aware that Newton changed the explanatory basis of astronomy, he shows no signs of having assimilated dynamic arguments in favor of Copernicanism. Perhaps, this is why there is no evidence that he thought there was a full proof for it. Nevertheless, from the point of Smith scholarship this new look at Hume has paid some dividends: we have found some more of the Humean roots for Smith's social epistemology, his attention to aesthetic criteria, and his interest in revolutions.

VII. Adam Smith and Copernicanism

1. Skeptical Realism

In a forthcoming article the distinguished scholar of Adam Smith, Ryan Hanley, argues that Adam Smith is a skeptical realist of the sort that other recent commentators have discerned in David

Hume[30]. For the sake of argument I am going to accept this reading of Hume. Hanley's main argument is the broad similarity between Hume's and Smith's views, but, in particular, he points to their shared emphasis on the epistemological importance of natural beliefs[31]. While I do not wish to deny many similarities between Hume and Smith (and have called attention to a few more such similarities in the previous sections), this skeptical realist interpretation of Smith cannot be sustained if we pay attention to Smith's treatment of science.

Note, first, that nowhere in Smith's oeuvre do we find the phrase "true philosopher" or "true philosophy" ever used. Second, in line with the "skeptical realist interpretation the Humean "true philosopher" accepts that there are limits to inquiry. Now there is a striking, and unappreciated example of Smith's rejection of Humean-style skepticism in the 'Astronomy'. Recall that in the first passage I quoted from the *Dialogues* above Cleanthes claimed that "the nourishment of bodies by food is still an inexplicable mystery". Cleanthes was echoing a standard Humean claim (providing a reminder that one should be cautious in identifying a particular character of the *Dialogues* with Hume). In EHU 4.2.16, Hume treats the unknown source of the nourishment of bread as an example of our "ignorance of natural powers", that is, how "nature has kept us at a great distance from all her secrets".

In the "Astronomy", Smith carefully circumscribes the 'we' implicit in Hume's bread example. Smith discusses the example *only* as an

30 Hanley, R.P. (2010).

31 Many have discerned a skeptical stance in Smith's psychological account of theory acceptance: Cremaschi, S. (1989); Pack, S.J. (1991), p. 114; Griswold, C. (1999), chapters 4, 8, and epilogue; Rothschild, E. (2002), pp. 138-140, p. 229. For recent counter-arguments, see Schliesser, E. (2005a) and (2006); Montes, L. (2008) and Berry, C. (2006). The classic reference to Hume's skeptical realism is Wright, J.B. (1983).

instance of the difference between the "bulk of mankind" and "philosophers". The former "seldom had the curiosity to inquire" about how bread is "converted into flesh and bones", while the latter have tried to find the connecting "chain" that can explain the "nourishment of the human body". Smith treats the example not as a confirmation of a kind of skepticism about possible knowledge of nature, but rather as a *research problem* not unlike the attempts to "connect the gravity, elasticity, and even the cohesion of natural bodies, with some of their other qualities"[32]. (For Smith "Philosophy is the science of connecting principles of nature")[33]. So the response to the Humean example shows that for Smith there is *some* distinction between the 'bulk of mankind' and 'philosophers'; it manifests itself in a difference in curiosity. This difference is largely the *effect* of the division of labor; from 'habit, custom and education' (WN I.ii.4, 28–29). For Smithian philosophers as opposed to Humean "true philosophers" inquiry never need come to an end. In the next sections I show that Hume's and Smith's treatment of Galileo and Newton exhibit, despite some surface similarity, equally striking differences.

2. Copernicanism and Newton

Hume interprets Newton's achievements in general as supporting his "true philosophy". In *The History of England*, he writes, "While Newton seemed to draw off the veil from some of the mysteries of nature, he shewed at the same time the imperfections of the mechanical philosophy; and *thereby* restored her ultimate secrets to that obscurity, in which they ever did and ever will remain" (VI, 542; emphasis added). Hume treats Newton's refutation of the mechanical philosophy as decisive evidence for the claim that nature will remain unknowable in principle 3. (In EHU 4.1.12, Hume also

32 EPS II. 9.

33 EPS II. 9.

limits what will be the 'ultimate causes and principles which we shall ever discover in nature', but in context he hedges his bets a bit). Perhaps this helps explain why Hume draws back from claiming that a full proof for Copernicanism has been given. If nature's ultimate secrets remain obscure, then full proofs are beyond reach.

In the "Astronomy", Smith remarks at length on the adoption of the Copernican System. While Smith is not blind to the efforts by Kepler and Galileo or Descartes and Gassendi (the latter two go unmentioned by Hume in this respect), the crucial episode in his narrative is his treatment of the status of the post-Galilean contribution of Cassini. Smith explains that Cassini's observations, which establish that the four known satellites of Jupiter and the five known satellites of Saturn obey Kepler's Equal Area rule and Kepler's Harmonic rule, were regarded by most astronomers and natural philosophers (he mentions Voltaire, Cardinal of Polignac, McLaurin, etc.) as decisive "demonstration" for the Copernican hypothesis. (Even Newton seems to appeal to it as a source of "principal evidences for the truth of" the Copernican 'hypothesis'). The appeal is to the preservation of the "analogy of nature", that is, to the similarity between the orbits of the planets around the Sun, and the moons of Jupiter and Saturn around these respective planets. This analogy does not hold in the Ptolemaic and Tychonic systems[34]. Notice that this analogical use of Cassini's observations is an extension of the Galilean arguments from analogy that Philo admires so much in the *Dialogues*. On Philo's views such arguments would provide more proofs for the fortifications supporting Copernican theory. (Again Hume's treatment in the *History* is compatible with Philo's but need not take the same line on analogy).

Smith is careful *not* to endorse this argument of Voltaire, MacLaurin, and others: "Yet, an analogy of this kind, it would seem,

34 EPS IV. 70.

far from a demonstration, could afford, at most, but the shadow of a probability"[35]. Smith explicitly *denies* that Cassini's observations provide conclusive evidence for the Copernican theory. At best, Cassini's observations raise the probability of the thesis, and then in an extremely limited fashion. It follows by implication that if Cassini's observations were not decisive then on Smith's view Galileo's earlier and less sophisticated analogical arguments were even less successful.

The insightfulness of Smith's criticism of Voltaire and the seventeenth and eighteenth-century astronomers and philosophers and his estimation of relative merits between MacLaurin and Voltaire have not been appreciated previously. Cassini's observations do not provide a principled explanation of why all the orbits in the planetary systems act like the planetary orbits in the solar system. This requires what Smith calls Newton's "physical account", that is, something more than an appeal to aesthetic and analogical considerations. Smith recognizes that the demonstrative part of Newton's exposition concerns the conditional, if–then, relationship between the nature of the force and the planetary orbits. But Smith stresses that Newton did not rest with this: "Having thus shown that gravity might be the connecting principle which joined together the movements of the Planets, he endeavoured next to prove that it really was so"[36]. Smith goes on[37] to describe how the Moon-test, Newton's amazing –entirely unsuspected by contemporary astronomers– prediction that a mutual attraction between Jupiter and Saturn would be strong enough to perturb their orbits when near conjunction, Newton's treatment of the Lunar orbit, Newton's account of the shape of the Earth, comets, and many other observations "*fully con-*

35 EPS IV. 93.

36 EPS IV. 108.

37 EPS IV. 67-75 and 98-104.

firmed Sir Isaac's System"[38] (emphasis added). Smith lists a number of surprising, different and independent kinds of evidence for accepting Copernican hypothesis.

In his exposition of Newton's system, Smith explicitly returns to the status of Cassini's observations. Newton's physical account provides what is missing in the original discussion about Cassini's observations[39]. Newton unified and reduced many apparently disconnected planetary phenomena to a "familiar principle of connection", that is, universal gravity. As Smith sums up his discussion of Newton: "Allow his principle, the universality of gravity, and that it decreases as the squares of the distance increase, and all the appearances, which he joins together by it, necessarily follow [...] It is every where the most precise and particular that can be imagined, and ascertains the time, the place, the quantity, the duration of each individual phaenomenon, to be exactly such, by observation, they have been determined to be". According to Smith, Newton's theory is not merely a more accurate and beautiful device for predicting known and previously unknown phenomena. It is also a tool for use in engaging in further, and fundamentally qualitatively improved kinds of inquiry. Moreover, Newton provides a principled –we would say dynamic– account of why the relative motions of bodies appear a certain way, and this account is fully confirmed by the phenomena. Smith endorses Newton's attempts "to prove [Sir Isaac's theory] really was so", *even* the "most skeptical cannot avoid feeling this"[40].

From the point of view of this article five things matter about Smith's account. First, Smith follows Hume in endorsing explana-

38 EPS IV. 107, the shape of the Earth can be predicted and explained (to first approximation) on the basis of rotational effects and universal inverse gravity (which below the surface of the Earth behaves as 1/r).

39 EPS IV. 67 and 98.

40 EPS IV. 117.

tory reductionism. Second, Smith's treatment of Copernicanism is far more fine-grained and detailed than Hume's[41]. Third Smith is unimpressed by the pre-Newtonian evidential status of analogical and aesthetic arguments in favor of Copernicanism, "an analogy of this kind, it would seem, far from a demonstration, could afford, at most, but the shadow of a probability". While at a certain level of generality this mistrust of analogy has a Humean flavor, Smith is far more dismissive of the pre-Newtonian "abstruse analogies" in favor of Copernicus, even if Cassini's observations "establish" Keplerian motion "as a law of the system"[42]. These pre-Newtonian arguments are not proofs, but "shadows of probabilities". Fourth, Smith recognizes in ways that Hume never did that Newton provided a whole new kind of evidence. Newton could offer a *physics* in which all the major features of Copernicanism could really be explained. Smith's recognition of this fourth point is why he thematically links the origins of Copernicanism with the demand for a consistent physical theory by Purbach and Regiomantus: "When you have convinced the world, that an established system ought to be corrected, it is not very difficult to persuade them that it should be destroyed. Not long, therefore, after the death of Regiomontanus, *Copernicus* began to meditate a new system, which should connect together the celestial appearances, in a more simple as well as a more accurate manner,

41 See, for example, "in the *Copernican* system, this appearance had hither to been connected with the other parts of that hypothesis, by supposing a small revolution in the Earth's axis from east to west. Sir Isaac Newton connected this motion by the same principle of gravity, by which he had united all the others, and shewed, how the elevation of the parts of the Earth at the Equator must, by the attraction of the Sun, produce the same retrograde motion of the Nodes of the Ecliptic, which it produced of the Nodes of the Moon. He computed the quantity of motion which could arise from this action of the Sun, and his calculations here too entirely corresponded with the observations of Astronomers". EPS IV. 114.

42 EPS IV. 92.

than that of Ptolemy"[43]. Fifth, Smith is aware that besides Galileo and Copernicus there were others, especially Descartes, that contributed to the acceptance of Copernican theory long before there were solid Newton proofs: "The Cartesian philosophy begins now to be almost universally rejected, while the *Copernican* system continues to be universally received. Yet, it is not easy to imagine, how much probability and coherence this admired system was long supposed to derive from that exploded hypothesis […] when the world beheld that complete, and almost perfect coherence, which the philosophy of Descartes bestowed upon the system of Copernicus, the imaginations of mankind could no longer refuse themselves the pleasure of going along with so harmonious an account of things"[44]. So, Smith is aware that the grounds of acceptance of a theory may appear more solid that they are[45].

Incidentally, Descartes is also credited for expanding the bounds of the universe: "the Solar Systems were infinite in number, each Fixed Star being the center of one: and he is among the first of the moderns, who thus took away the boundaries of the Universe; even *Copernicus* and Kepler, themselves, having confined it within, what they supposed, the vault of the Firmament"[46]. Somewhat surprising Smith does not mention Galileo's *Starry Messenger* in this context.

43 EPS IV. 48.

44 EPS IV. 104.

45 "Nor can any thing more evidently demonstrate, how easily the learned give up the evidence of their senses to preserve the coherence of the ideas of their imagination, than the readiness with which this, the most violent paradox in all philosophy, was adopted by many ingenious astronomers, notwithstanding its inconsistency with every system of physics then known in the world, and notwithstanding the great number of other more real objections, to which, as *Copernicus* left it, this account of things was most justly exposed". EPS IV. 61.

46 EPS IV. 101.

3. Smith and Hume on Galileo's method

In this final section, I call attention to a striking similarity between Hume and Smith on the method of Galileo. The similarity also reveals their differences, or so I shall argue here.

First, while on my reading Smith and Hume part ways over post-Galilean science, Smith agrees with Hume that Galileo made seminal contributions in defense of Copernican theory. Here's Smith's treatment of how until Galileo came along Copernicans were unable to answer standard objections to the doctrine:

"The objection to the system of *Copernicus*, which was drawn from the nature of motion, and that was most insisted on by Tycho Brahe, was at last fully answered by Galileo; not, however, till about thirty years after the death of Tycho, and about a hundred after that of *Copernicus*. It was then that Galileo, by explaining the nature of the composition of motion, by showing, both from reason and experience, that a ball dropt from the mast of a ship under sail would fall precisely at the foot of the mast, and by rendering this doctrine, from a great number of other instances, quite familiar to the imagination, took off, perhaps, the principal objection which had been made to this hypothesis"[47].

In fact, while Smith avoids the language of proof, he is willing to concede that "the unfortunate Galileo was adding so many probabilities to the system of *Copernicus*"[48]. Smith also emphasizes that "Galileo, who first applied telescopes to Astronomy, discovered, by their assistance, the Satellites of Jupiter, which, revolving round that Planet, at the same time that they were carried along with it in its

47 EPS IV. 69. See also: "It is amusing to observe, by what subtile and metaphysical evasions the followers of *Copernicus* endeavoured to elude this objection, which, before the doctrine of the Composition of Motion had been explained by Galileo, was altogether unanswerable". EPS IV. 66.

48 EPS IV. 71.

revolution, round either the Earth, or the Sun, made it seem less contrary to the analogy of nature, that the Moon should both revolve round the Earth, and accompany her in her revolution round the Sun"[49].

Not unlike Hume, Smith admires Galileo's methodology. This comes out in a striking contrast that Smith draws between Kepler and Galileo: "Kepler, with great genius, but without the taste, or the order and method of Galileo, possessed, like all his other countrymen, the most laborious industry, joined to that passion for discovering proportions and resemblances betwixt the different parts of nature, which, though common to all philosophers, seems, in him, to have been excessive"[50]. Galileo has taste, "order and method", and this contrasted with Kepler's excessive use of analogy.

In fact, Smith describes Galileo's method in nearly the same words as Hume does; compare Smith's locution that Galileo explained "the nature of the composition of motion, by showing, both from reason and experience", with Hume's locution about Galileo's method, "derived both from reason and the senses". It is this method that Smith finds at its most striking in Newton: "But of all the attempts

49 EPS IV. 69; see also Smith's treatment on Galileo's discoveries of the phases of Venus: "It had been objected to *Copernicus*, that, if Venus and Mercury revolved round the Sun, in an orbit comprehended within the orbit of the Earth, they would show all the same phases with the Moon, present, sometimes their darkened, and sometimes their enlightened sides to the Earth, and sometimes part of the one, and part of the other. He answered, that they undoubtedly did all this; but that their smallness and distance hindered us from perceiving it. This very bold assertion of *Copernicus* was confirmed by Galileo. His telescopes rendered the phases of Venus quite sensible, and thus demonstrated, more evidently than had been done, even by the observations of Tycho Brahe, the revolutions of these two Planets round the Sun, as well as so far destroyed the system of Ptolemy". EPS IV. 71.

50 EPS IV. 71.

of the Newtonian Philosophy, that which would appear to be the most above the reach of human *reason and experience*, is the attempt to compute the weights and densities of the Sun, *and* of the Several Planets. An attempt, however, which was indispensably necessary to complete the coherence of the Newtonian system"[51] (emphasis added).

Elsewhere I have explored the ways in which Smith's *Wealth of Nations* can be said to be based on a self-described Newtonian methodology[52]. It is worth adding to these arguments that in WN Smith appeals twice to "reason and experience"[53]. Hume occasionally appeals to "reason and the senses" in his own voice (e.g. *Treatise* 1.4.1.5 & 2.3.3.3 and, especially, the long footnote at EHU 5.5). Nevertheless, Smith's position contrasts sharply with Hume's famous line, "This sceptical doubt, both with respect to reason and the senses, is a malady, which can never be radically cur'd, but must return upon us every moment, however we may chance it away, and sometimes may seem entirely free from it" (1.4.2.57). The Humean "true philosopher" is simply more skeptical than Smith's philosopher.

51 EPS IV. 117.

52 Schliesser, E. (2005b).

53 This is an especially striking example: "Were all nations to follow the liberal system of free exportation and free importation, the different states into which a great continent was divided would so far resemble the different provinces of a great empire. As among the different provinces of a great empire the freedom of the inl*and* trade appears, both from *reason and experience*, not only the best palliative of a dearth, but the most effectual preventative of a famine; so would the freedom of the exportation *and* importation trade be among the different states into which a great continent was divided. WN IV.v.3. See also WN IV.vii.1 and TMS I.iii.2.

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