How did British periodicals conceptualize the Nebular hypothesis in their reception of *Vestiges of the Natural History of Creation* in 1844-1846?

[7320 / 4000 words]

Research Essay
Science and the Public

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Contents

Questions

- What made the argument in *Vestiges* such a powder keg in the 1840s?

- (it did what elite scientists were terrified of doing: it took the private, cautious conversations of the drawing room and shouted them from the rooftops.)
- proposed a Grand Unified Theory which the middle-classes were hungry for to displace the existing Grand Unified Theory that results from the book of nature were beginning to put into question.

Topics

- Natural theology
- General Providence and Special Providence
- Scientists as guardians of the social order (Sedgwick was an anglican minister??)

Relevant quote from Bensaude-Vincent

We consider the "co-production of science and its 'others'" (i.e in excluding women)

Just like Bensaude-Vincent argues that the boundary work done by Avicenna (attacking alchemists as charlatans) advanced knowledge by spurring alchemists to advance cupellation and cementation, so Sedgwick's attacks may have done the same to Darwin, prompting him to spend time studying barnacles and amassing a lot more evidence for his evolutionary theory in 1859 than it did in 1844.

Introduction: What are we doing and why is it interesting?

In discussing the 5 interest groups as they are shown in our newspapers, we come to feel the impact of Bensaude-Vincent's conclusion that: "Even the generic term "the public," often used to describe an undifferentiated mass of passive consumers, has been superseded by the political term "citizens," which suggests a variety of motivated individuals or informed groups, acting as respon- sible actors and members of civil society."

Although modern planetary formation theory differs significantly from nineteenth-century formulations, the core idea that solar systems form from collapsing gaseous matter is now accepted scientific fact. In the mid-nineteenth century, this 'Nebular Hypothesis' was hotly contested, and its reception provides a case study in the study of communication of scientific knowledge with the wider public.

This research essay will study reviews of the 1844 anonymously published *Vestiges of the Natural History of Creation (1844)* to find out how this hypothesis was understood by various British periodicals in the mid-nineteenth century. The essay therefore addresses the call made by Cooter and Pumfrey in 1994 to increase the study of the role of the press in the diffusion of science [1]. Why did the *Examiner* give the book a raving review? Why was the *Mercury* more cautious in accepting the substance, but righteous in its defense of the anonymous author against the attacks by the Royal Society.

Studies of science in popular context have argued that the production of socially relevant knowledge about the natural world is not the sole preserve of scientists, but a co-production between scientists, popularizers, and various publics [1], [2]. The anonymous publication of the *Vestiges of the Natural History of Creation* in 1844 is an example. It caused a sensation, with a deluge of ink spilled by scientists, newspaper columnists and diarists to attack or to defend the theory on points of technical substance and on wider social implications. These points were absorbed by the author, who published 10 subsequent, heavily revised editions in the ensuing 9 years, the last of which Charles Darwin called "much improved" [3]. This iterative process of production, incorporating ideas stemming from what historian Natalie Zemon Davis has called "the creative competence of the lower orders" is a demonstration of this co-production.

The anonymous author of Vestiges, Robert Chambers, was a prosperous Scottish bookseller and editor rather than a career scientist. However, he was deeply embedded in the era's intellectual landscape as an active member of the Geological Society of London and the Royal Society of Edinburgh. He also held an early membership in the Edinburgh Phrenological Society[1]. These affiliations facilitated a steady correspondence with the period's leading scientific minds, allowing Chambers to absorb the conventions of "gentlemanly" scholarly writing. This mimicry of elite scientific discourse was precisely what his detractors in the academy found so alarming: he possessed the stylistic tools of a scientist without the official credentials.

The Vestiges is significant not just because it is an example of a widely read popular science work, but because it aimed to do something new. The book was, to the author's knowledge, the "the first attempt to connect the natural sciences into a history of creation" [4].

Victorian society held certain theological beliefs that appeared at odds with an evolutionary universe. Howard Gruber has argued that Darwin's reluctance to publish his argument that evolutionary change is brought about because "variations" that are "beneficial to the being under its conditions of life" are *naturally selected* for[2] can be explained by his recognition that theology would be badly shaken by them. In light of this, we can see *Vestiges* and the vigorous debate that it unleashed as doing important work that would help the reception of Darwin's ideas twenty years later. Darwin certainly felt that way, writing in 1871 about the role *Vestiges* had in "removing prejudice" and "preparing the ground for the reception of analogous views". Nevertheless, we should not go so far as to say that *Vestiges* inspired Darwin's scientific ideas. In fact, letters show that by 1844 Darwin had already written an essay outlining his theory, and he was sufficiently confident in it to ask his wife to publish it in the event of his early death [5].

Beer [5] argues that Victorian Society was deeply imbued with the language and values of "design".

Natural theology believed that "all manifestations of nature are aspects of a relationship between God and Man" [5]. Darwin himself was beset by doubts and by the fear that he would cause pain to his wife Emma, who was devoutly religious [5].

Darwin also criticized early editions for showing "little accurate knowledge and a great want of scientific caution." Perhaps he had in mind the brutal reception the book received from figures such as Adam Sedgwick, whose review exemplified the risks of speculative natural philosophy. Darwin was keen to distance himself from such speculation, insisting instead on the care of his own method: "After five years' work I allowed myself to speculate […] I have not been hasty in coming to a decision" [3]. The reputational stakes were high for Charles Darwin, who never intended to be shielded by the anonymity enjoyed by the author of Vestiges of the Natural History of Creation. Moreover, his argument was more unsettling to the public than either Vestiges or that of Alfred Russel Wallace. Vestiges presents the development of life as essentially progressive, while Wallace reserved a special place for humans. Darwin did not: he fully integrated humans into the rest of natural history and rejected the idea of any steady, universal progression toward increasing complexity across all species [5].

Something that was at stake for the nineteenth century audience was wether their worldview was fundamentally uplifting or depressing. Darwin was aware of this, defending that "There is grandeur in this view of life, with its several powers, having been originally breathed [by the Creator] into a

[1]Phrenology is a discredited theory involving the measurement of skull shape to predict mental traits; Edinburgh was then the primary British hub for the practice

[2]Darwin's observations were made on board the HMS Beagle in the late 1830s but his revolutionary Origin of Species only appeared in 1859

few forms or into one. (p. 360)" [5]. When he says this we will see that he is echoing arguments made in the mid-1840s in the press.

The book was important because it "brought into question a settled cosmos" [5]. The episode raises a broader question about epistemic authority: who was entitled to speculate—the public, or the scientific elite?

Through his correspondence with various naturalists and scholars, Chambers absorbed the conventions of gentlemanly scientific writing — a skill the Edinburgh Review would later condemn as especially dangerous in the hands of someone who has produced such a speculative work infused with "base materialism".

The fact that the book went through 14 editions [6]

The public response was read and absorbed by Robert Chambers, who released 14 subsequent editions and a sequel called *Explanations* to respond, clarify, and edit the work - illustrative of the fact that this episode of popular science must be viewed as a co-creation between the popularizer and the audience. So what was the audience saying?

To understand the critique we must first understand the argument, so will begin by developing an acquaintance with the Nebular Hypothesis itself, as it is laid out in *Vestiges*. Then we will turn to various periodicals representing a cross section of British society, from the quarterly *Edinburgh Review* to the provincial *Liverpool Mercury*. By understanding how they engaged with the Nebular hypothesis, we will find out why different segments of society believed or disbelieved it.

By evaluating both the empirical critiques and the cultural anxieties found in the press, this essay highlights what was truly at stake for the Victorian public when discussing the origins of the solar system, and which moral and political fault lines become visible.

We will further understand how various newspaper readerships defined their relationship to the Nebular Hypothesis, responding to Cooter and Pumfrey's call to "may have been fulfilled by lay thinking of nature"

The Nebular Hypothesis in Vestiges

Writing for the *Edinburgh Review*, Adam Sedgwick gave the Nebular Hypothesis a fair summary by saying it "assumes that the sun and planets were once in a nebulous condition, and have been elaborated out of it, in subordination to the laws of gravity, in a long-continued process of condensation". Before analyzing what contemporaneous newspapers had to say about the *Nebular Hypothesis*, it will be useful to develop a working acquaintance with some of the details of the hypothesis itself so that we can better gauge its reception and critique.

Much of Robert Chambers' knowledge of the Nebular Hypothesis is likely to have come from the popularizer John Pringle Nichols, the *Liverpool Mercury* commenting that he seems to have taken it "cut and dry" from Nichols' book. Nevertheless, Chambers does not quote Nichols, instead preferring to quote Comte, Laplace, and Kepler to bolster his arguments. He does not claim he is presenting anything new, only presenting what has been 'common knowledge' among amongst astronomers and geologists for decades.

He presents the Nebular Hypothesis in his first Chapter. The point of the chapter on the nebular hypothesis is not so much to add to scientific knowledge, but to "connect the natural sciences in a history of creation", to use his words.

The Nebular Hypothesis as Laid out in Vestiges: Laws of Attraction and Centrifugal Force

In Vestiges, the nebular hypothesis is presented as follows: Early in the history of the solar system, it was just a cloud of gas, akin to the nebulae that have had recently been observed by the "two Herschel"[3]:

> The two Herschel have in succession made some other most remarkable observations in the regions of space. They have found within the limits of our astral system, and generally in its outer fields, a great number of objects which, from their foggy appearance, are called nebulae.
>
> — [7]

Somehow (here Chambers admits ignorance as to the exact mechanism), areas of high density would appear at or near the center of the nebulae. These nuclei would then grow in size under gravity: "it is a known law in physics that, when fluid matter collects towards or meets in a center, it establishes a rotatory motion"[4]. The "law of centrifugal force" is then invoked to explain why rings of mass have flung from these primordial stars to coalesce into planets, while analogously rings of mass have flung off from planets to coalesce into moons [7]. Chambers explains that for such 'flinging off' to occur, the centrifugal force must exceed the attractive force, and he somewhat curiously[5] attributes this to refrigeration:

> From what cause might arise the periodical occurrence of an excess of the centrifugal force? If we suppose the agglomeration of a nebulous mass to be a process attended by refrigeration or cooling, which many facts render likely, we can easily understand why the outer parts, hardening under this process, might, by virtue of the greater solidity thence acquired, begin to present some resistance to the attractive force."
>
> — [7]

These rings then coalesce into planets due to their own self-gravitation:

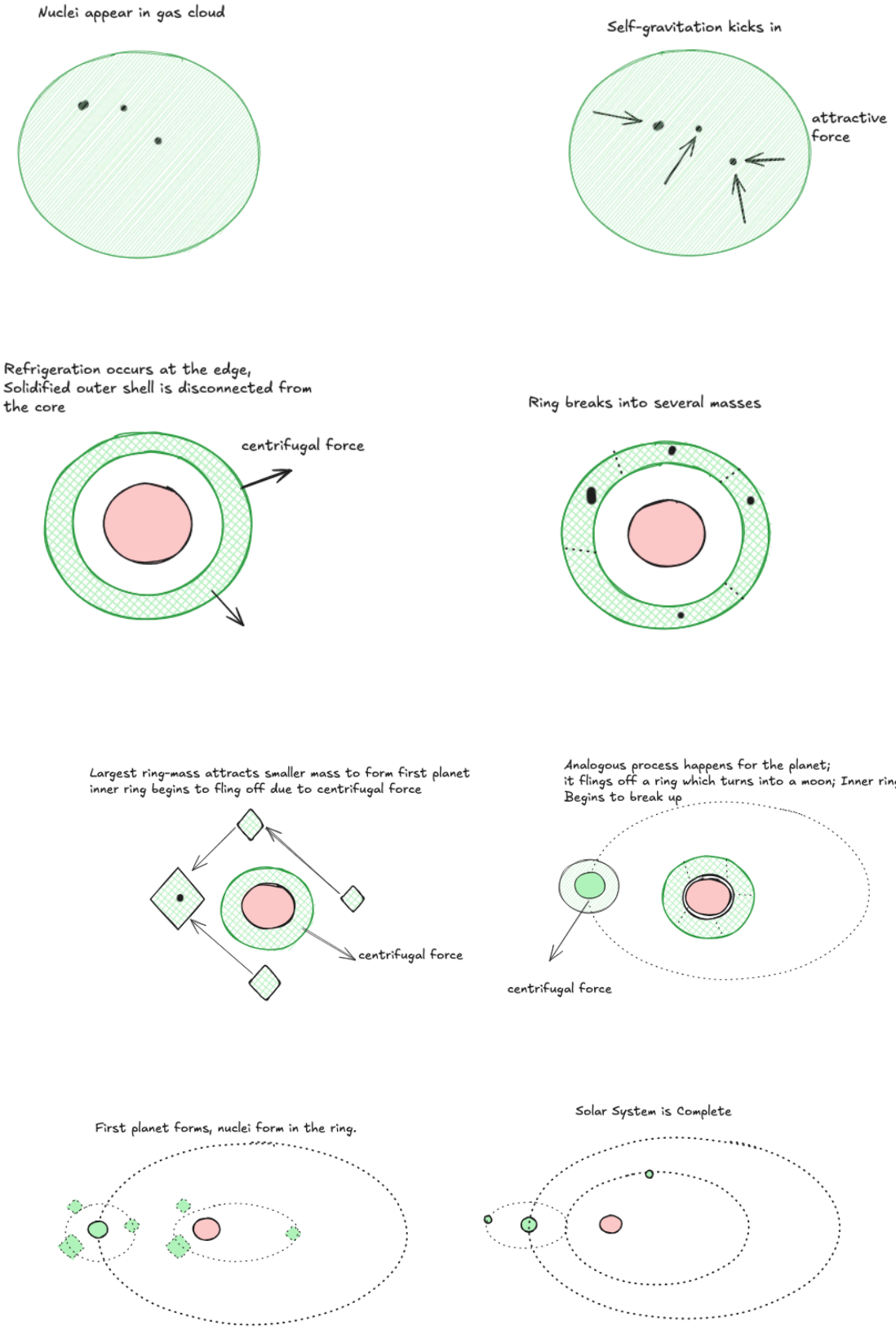
> If these rings consisted of matter nearly uniform throughout, they would probably continue each in its original form; but there are many chances against their being uniform in constitution. The unavoidable effects of irregularity in their constitution would be to cause them to gather towards centers of superior solidity, by which the annular form would, of course, be destroyed. The ring would, in short, break into several masses, the largest of which would be likely to attract the lesser into itself."
>
> — [7]

I have sketched the process as described by Chambers [7] below:

[3] Sir William Herschel and his son

[4] Today we would phrase this in terms of the conservation of angular momentum "angular momentum is conserved, therefore if the moment of inertia is reduced then the angular velocity must increase" (the example of a ice skater pulling in her arms is a good one)

[5] Newtonian physics teaches us that centrifugal force is independent of the state of matter, but only dependent on the *quantity of matter* or mass, and its velocity



Chambers is confident that the evidence for the Nebular Hypothesis is overwhelming:

> The nebular hypothesis is, indeed, supported by so many ascertained features of the celestial scenery, and by so many calculations of exact science, that it is impossible for a candid mind to refrain from giving it a cordial reception
>
> — [7]

Let's now turn to some of this evidence.

Observed Nebulae form a continuum

The first piece of evidence for the nebular hypothesis is that Nebulae form a continuum, from more gas-like to more solar-system like. These appear to show snapshots of a single process of solar system formation.

> [...] nebulous stars exist in every stage of concentration, down to that state in which we see only a common star with a slight bur around it. It may be presumed that all these are but stages in a progress, just as if, seeing a child, a boy, a youth, a middle-aged, and an old man together, we might presume that the whole were only variations of one being[6]. Are we to suppose that we have got a glimpse of the process through which a sun goes between its original condition, as a mass of diffused nebulous matter, and its full-formed state as a compact body?
>
> — [7]

and:

> If we could suppose a number of persons of various ages presented to the inspection of an intelligent being newly introduced into the world, we cannot doubt that he would soon become convinced that men had once been boys, that boys had once been infants, and finally, that all had been brought into the world in exactly the same circumstances. Precisely thus, seeing in our astral system many thousands of worlds in all stages of formation, from the most rudimental to that immediately preceding the present condition of those we deem perfect, it is unavoidable to conclude that all the perfect have gone through the various stages which we see in the rudimental.
>
> — [7]

Patterns in the Solar System

Next, Chambers points out several patterns in the solar system that he attempts to explain using the Nebular Hypothesis

Uniformity of Angular Momentum

Chambers notes that the planets all orbit nearly in one plane, and that the motions of the Sun on its axis, the planets around the Sun, and the satellites around their respective primaries—and in many cases their rotations as well—share a common direction, namely from west to east. He argues that this degree of alignment cannot be attributed to accident. Indeed, he cites Laplace's estimate that the probability of such an arrangement arising by chance, assuming a random distribution of orbital and rotational angular momenta, is on the order of four trillion to one. On this basis, Chambers concludes that the observed uniformity demands a common explanation. [7]

[6] It is interesting to note that Charles Darwin used an analogous reasoning process in his publication on Coral Reefs two years earlier, arguing that each reef type was really a separate stage of reef development around a slowly sinking volcanic island https://www.coraldigest.org/reef_structure/darwinstheory/index.html#cite_note-palaces-2

Relative densities of planets

Another striking pattern is that planets closer to the sun are denser than planets further away:

> Some of the other relations of the bodies are not less remarkable. The primary planets shew a progressive increase of bulk and diminution of density, from the one nearest to the sun to that which is most distant. With respect to density alone, we find, taking water as a measure and counting it as one, that Saturn is $\frac{13}{32}$, or less than half; Jupiter, $1\frac{1}{24}$; Mars, $3\frac{2}{7}$; Earth, $4\frac{1}{2}$; Venus, $5\frac{11}{15}$; Mercury, $9\frac{9}{10}$[7] or about the weight of lead.
>
> — [7]

Interestingly, Chambers leaves out Uranus, which was known to be more, not less dense than Saturn, a point which Sedgwick picks up on in his review [8].

Solar System distances of planets

The distances of the planets in the solar system also seem to have a pattern that begs explanation[8]:

> It has been found that if we place the following line of numbers:
>
> 0 3 6 12 24 48 96 192
>
> and add 4 to each, we shall have a series denoting the respective distances of the planets from the sun. It will stand thus:

4	7	10	16	28	52	100	196
Mercury	Venus	Earth	Mars		Jupiter	Saturn	Uranus

> It will be observed that the first row of figures goes on from the second on the left hand in a succession of duplications, or multiplications by 2.
>
> Surely there is here a most surprising proof of the unity which I am claiming for the solar system. It was remarked when this curious relation was first detected, that there was a want of a planet corresponding to 28; the difficulty was afterwards considered as in a great measure overcome, by the discovery of four small planets revolving at nearly one mean distance from the sun, between Mars and Jupiter. The distances bear an equally interesting mathematical relation to the times of the revolutions round the sun.
>
> — [7]

Chambers does not explicitly explain why the Nebular Hypothesis explains these values, but we can assume that he wants to drive home the point that these patterns in the solar system seem to indicate a common origin.

Interestingly, Chambers does not choose to plot any of these values. Presumably he did not think that the following graphs would boost his argument:

[7] Today's estimates for the densities of these planets differ considerably and do not show as striking a pattern

[8] This is known as Bode's Law, see: https://en.wikipedia.org/wiki/Titius%E2%80%93Bode_law. Today it is considered a mathematical coincidence

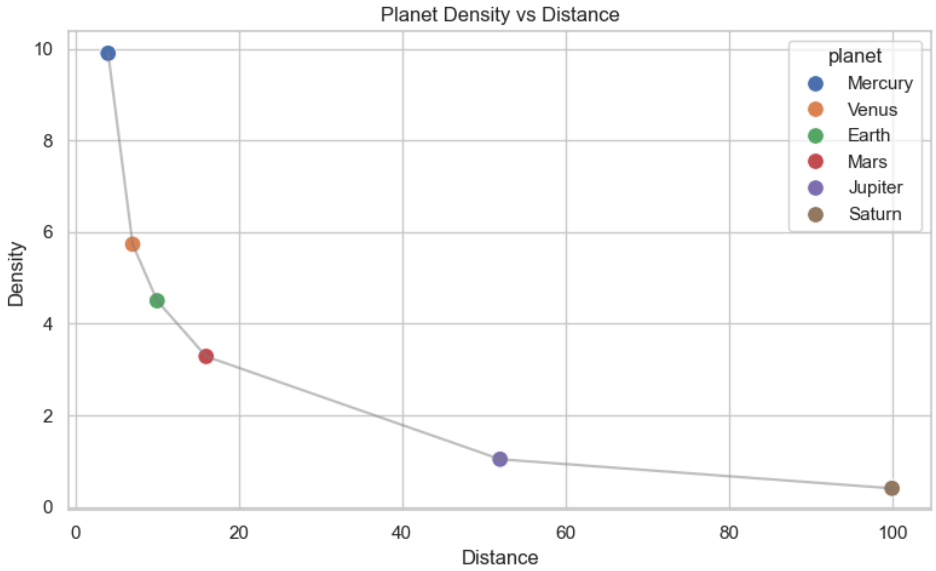


Figure 1: We have plotted the numbers that Chambers gives to show a inverse-square relationship between planetary density and distance from the sun. This is not immediately obvious from the quote. The values plotted are the ones known to Chambers in 1844.

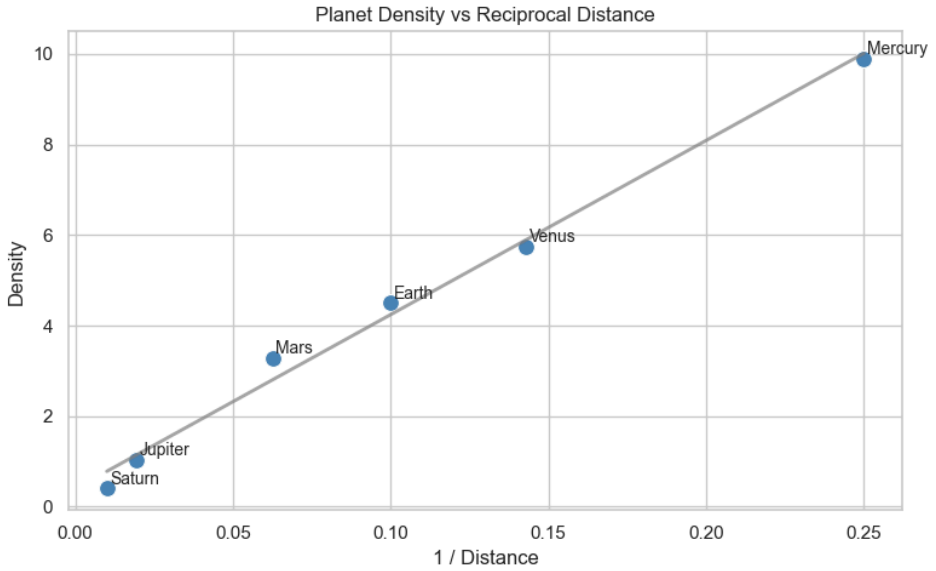


Figure 2: We have plotted the numbers that Chambers gives to reveal a linear relationship between the Planet Density and the Reciprocal Distance. It is striking that Chambers did not plot these values, as the results are very much in agreement with a straight line. Perhaps it would have added to the cost of printing

Kepler's Law: Bad Argument, Good Pedagogy

Next, Chambers appeals to Kepler's Law to show the harmony in the solar system:

> It has been found that, with respect to any two planets, the squares of the times of revolution are to each other in the same proportion as the cubes of their mean dis- tances,-a most surprising result, for the discovery of which the world was indebted to the illustrious Kepler.
>
> — [7]

Strictly speaking, Chambers' appeal to Kepler's Third Law—the harmonic relationship between a planet's distance and its orbital period—provides no empirical mechanism for a nebular origin. As Sedgwick and other elite critics were quick to point out, these mathematical regularities had been fully integrated into Newtonian mechanics for over a century and did not require a gaseous precursor to function. However, if Vestiges is viewed not as a formal treatise for the Royal Society but as a didactic project for the masses, as Chambers' dedication to cheap print reveals it to be, the inclusion of Kepler makes tactical sense. Chambers provides the lay reader with a key part of Newtonian cosmology. For a public being introduced to the "celestial scenery" for the first time, these laws serve as an educational baseline.

M Compte's Calculation

Chambers quotes a certain M Compte from Paris[9], who calculated, given the sun's angular momentum, what the average rotational period would have been if its radius extended to that of the planets. In each case he found a rotation close to the orbital period of the planet at that distance. The same procedure was done for the moon. For a less dense earth with a radius the extending to the lunar orbit, the length a day corresponded to about one moon's orbital period. This calculation is not reproduced in the text as "The process by which he arrived at this conclusion is not to be readily comprehended by the unlearned"

> M Compte of Paris has made some approach to the verification of the hypothesis, by calculating what ought to have been the rotation of the solar mass at the successive times when its surface extended to the various planetary orbits. He ascertained that *that rotation corresponded in every case with the actual sidereal revolution of the planets, and that the rotation of the primary planets in like manner corresponded with the orbitual periods of the secondaries*
>
> — [7]

M Compte's calculation provides evidence for the part of the nebular hypothesis which states that rings at the edge of the self-gravitating mass fling off due to the centrifugal force. If they do fling off, we would expect them to have a rotationary motion precisely equal to that which the sun had at that point in time.

Double and Triple stars

> Some double stars, upon which careful observations have been made, are found to have a regular revolutionary motion round each other in ellipses. This kind of solar system has also been observed in what appears to be its rudimental state, for there are exampes of nebulous stars containing two and three nuclei in near association.
>
> — [7]

Having drawn the analogy before between the law of gravitation and whirlpools of water, he says "it may often be observed that two or more dimples are formed near each other with more or less regularity"

[9]This is likely Auguste Compte, 1798-1857, who mostly worked in philosophy and social theory, coming up with logical positivism. He once wrote: 'It is evident, the Solar System is badly designed'. He also did some work on solar system astrophysics, which was heavily criticised as having "no benefit" by Adam Sedgwick

Consequences of the Nebular Hypothesis

Chambers draws a few conclusions from the Nebular Hypothesis. First, that whole of our firmament was at one time a bunch of diffuse matter, including other astral systems. Second, the formation of bodies in space "is *still and at present in progress*".

It is somewhat surprising that Chambers, after describing how rings of matter turn into planets and moons, does not therefore conclude that Saturn's rings will do so in the future. Instead, we have already attained perfection:

> Our own solar system is to be regarded as completed, supposing perfection to consist in the formation of a series of planets [...] there are other solar systems within our astral system, which are as yet in a less advanced state, and even some quantities of nebulous matter which have scarcely begun to advance towards the stellar form
>
> — [7]

So the implication is that while bodies in the entire universe are still evolving, our solar system has basically stopped, having attained the pinnacle of perfection. I must point out the analogy with the pre-Darwinian view of Evolution, in which an improving environment yields to more and more complex species, at the pinnacle of which stands Victorian Man.

Chambers also concludes that we are not the oldest star system:

> There is one piece of evidence for the probability of the comparative youth of our system, altogether apart from human traditions and the geognostic appearances of the surface of our planet.[...] a thin nebulous matter which is diffused around the sun to nearly the orbit of Mercury [...] bears the name of the Zodiacal Light [...] has been thought a residuum or last remnant of the concentrating matter of our system, and thus may be supposed to indicate the comparative recentness of the principal events of our cosmogony.
>
> — [7]

Finally, the mechanism by which a rotating, shrinking cloud periodically flings off a portion when the centrifugal force exceeds the attractive one leads Chambers to conclude that The Earth is older than Venus and Mercury, but younger than Mars, Jupiter, Saturn, and Uranus.

Difference with Modern Physics

There are two big differences with modern physics that occur to the modern reader. First, Chambers strongly equates gravity with electrostatic attraction:

> The tear that falls from the childhood's cheek is globular, through the efficacy of that same law of mutual attraction of particles which made the sun and planets round
>
> — [7]

We will not fall into the presentist trap of saying this is wrong. In fact, Many thinkers (including Michael Faraday) were actively trying to link electricity, magnetism, and gravity. It is only fitting for a speculative work like *Vestiges* to anticipate (wrongly, in this case) that these laws will soon be unified.

Second, the centrifugal force is taken to increase when an object solidifies. In fact, centrifugal force is independent of the state of matter of the object, and depends only on its distance and speed of rotation.

Sedgwick's Scathing Review in *The Edinburgh Review*

Sedgwick understood that science was "the most potent instrument of persuasion in our culture" [9], and worried that anonymous figures like Sedgwick would ride on the coat-tails of cautious empirical inquiry and lead the public down dangerous conclusions. With great power, came the responsibility of scientific caution.

Having discussed at length the argument for the nebular hypothesis presented in *Vestiges*, we now turn to its reception in the British Press. We order this section chronologically, and start with a scatching review by Professor Adam Sedgwick.

In July 1845, The *Edinburgh Review* published a 80-page anonymous rebuttal, widely understood to have been written by the geologist Adam Sedgwick. It attempts to respond candidly to "every material point of his argument". It is scathing in its conclusions:

> He fails from his first beginnings- he understands not the present condition of the Nebular Hypothesis- and admitting the truth of the Hypothesis, he has drawn from it the most unwarrantable conclusions
>
> — [8] p. 83

Attacks on the anonymous author and His Audience

The review begins with a lengthy "anatomy of the author's mind", describing the work as one in which "everything is touched upon, while nothing is firmly grasped," and insisting that its claims are built on second-hand knowledge, misinterpretation, and conjecture. At the level of scientific method, Sedgwick presents Vestiges as a fundamental violation of the principles of inductive science. For Sedgwick, legitimate scientific knowledge is the product of cumulative labour across generations, requiring disciplined engagement with empirical facts. The author of Vestiges, by contrast, is portrayed as having no "just conception" of these methods, and thus no authority to advance sweeping cosmological theories. Sedgwick insists that only those who have undergone the "rugged and thorny" ascent of scientific training have the right to speculate publicly. In this sense, his review is not merely an evaluation of a theory, but a defence of the social structure of knowledge production. The anonymous, popular author of Vestiges—a figure who writes across disciplines and addresses a mass readership—is cast as an illegitimate "legislator over the material world." Sedgwick's attack thus reflects anxiety about the erosion of distinctions between expert and lay knowledge in an expanding print culture. He also writes with a note of panic that certain classes of people should be kept away from this sort of writing:

> If our glorious maidens and matrons may not soil their fingers with the dirt knife of the anatomist, neither may they poison the springs of joyous thought and modest feeling, by listening to the seductions of this author who tells them - that their Bible is a fable when it teaches them that they were made in the image of God, that they are the children of apes and the breeders of monsters - that he has *annulled all distinction between physical and moral* - and that all the phenomena of the univers, dead and living, are to be put before the mind in a new jargon, and as the progression and development of a rank, unbending, and degrading materialism.
>
> — [8]

The review also contains a strikingly hostile portrayal of the book's audience. Sedgwick attributes its popularity to readers incapable of serious scientific judgement, describing them as consumers of "trashy skimmings of philosophy." He explicitly contrasts this public with the community of "men who have any name in science," none of whom, he claims, regard the work with anything but "deep aversion." In doing so, he constructs a sharp divide between elite scientific authority and a credulous reading public, whose tastes and intellectual capacities are implicitly disparaged, and who must be instructed by the schoolmen.

Finally, the weak grasp of scientific facts leads Sedgwick's to initially conclude that the work was penned by a woman, only to change his mind when confronted by its materialism.

> It was from [...] the great physical blunders, that we were first led to refer 'the Vestiges' to the science gleaned at a lady's boarding-school; but its rank materialism soon deceived us.
>
> — [8]

Sedgwick uses this as an example to insist that science is not the proper preserve of women:

> We know, by long experience, that the ascent up the hill of science is rugged and thorny, and ill-fitted for the drapery of a petticoat
>
> — [8]

while simultaneously depicting women as being above the despicable philosophy of 'materialism', from which they ought to be protected.

Attack on the Nebular Hypothesis

For Sedgwick, "assuming the truth of the nebular hypothesis [...] in the present state of our knowledge [...] is a very bold assumption". He argues that it is "but a splendid vision" which has not gained much creedence since it was proposed a century ago by Laplace, who demonstrated that it is in principle possible for spinning self-gravitating gas will fling off rings of matter.

Sedgwick mentions that John Herschel, whose work he hails as a "model of philosophical caution", in contrast to the "unbridled speculations" of the author of Vestiges, does not use the term "nebular hypothesis" once. He then recounts the discoveries nebulae by Sir William Herschel, but points out that what appear to be clouds of gas have been shown to just be many faint stars when observed with a more powerful telescope:

> All of them when seen with instruments of low power, look like masses of luminous vapour [...] but when these luminous masses are examined by instruments of higher power, many of them lose their cloudy forms, and are thus resolved into luminous points, 'like spangles of diamond dust' [...] there naturally arises a question, whether all of them may not at last be thus resolved into luminous points
>
> — [8], p19

Sedgwick says that the nebular hypothesis give us more questions than answers, for example it seems like a rotating cloud could not produce the amount of angular momentum we see today: "we cannot [...] suppose that that an irregular collapse of the primeval nebula of our system could account for its rotation about one centre. No mere shrinking force could produce such a regular rotation. His attempt at reasoning on this point is his first great physical blunder".

Sedgwick then critiques the *Vestiges* use of Kepler's law: "the use made of it by our author only serves to show that he is unacquainted with the fundamental laws of motion. It is impossible to deduce Kepler's law (as M Compte has most vainly attempted) from the condensation of a nebula".

Nothing, Sedgwick hastens to add, has been done of the Nebular Hypothesis since the time of Laplace. As for M Compte's supposedly profound calculation, it is "only an illustration of the fact that the motion of a planet revolving in an orbit nearly circular, are not affected by the magnitude of the central spherical body". In other words, it is just a property of gravity, the same "period coincidence" would happen even if no rings were ejected, purely from gravity and conservation of angular momentum.

As to the argument about the densities of the planets appearing in a striking order, with Mercury the most dense and Uranus the least dense, this is simply wrong, says Sedgwick. "The densities of Venus, Earth, and Mars, are not in such an order; and the density of Uranus is greater than that of Saturn". Moreover, not all satellites travel from west-east, Uranus' moons being a notable exception.

To conclude, the nebular hypothesis is "utterly unfit to form the basis of any system of nature", such as our author presumes to erect upon it"

Liverpool Mercury points out the Hypocricy and Theory-phobia of the Schoolmen and a Defense of Speculation

In October 1845, the Liverpool Mercury published a rebuttal to Adam Sedgwick's harsh July review [10]. It adopts a slightly satirical tone, and clearly sets up a dichotomous relationship between "our readers, the reading and thinking public", and a slightly patronising tone towards "our schoolmen" or "philosophers" who are "scandalized" by the ideas in *Vestiges*.

The *Mercury's* Audience

The *Liverpool Mercury* originated in Liverpool in 1811, and had an average circulation of 7000 [11]. It was a self-consciously "provincial" paper, but its national and international reporting meant it circulated throughout England. It cost six pence[10]. Its motto, *Salus Populi Lex Suprema*[11], revealed their founders' long-term aim as 'continual and peaceful progress'. The Mercury was a staunch campaigning newspaper fighting for better housing and public health in Liverpool [13]. The newspaper therefore is likely to have been read by middle-class and reform-minded readers, interested in social improvement and progressive politics. We will follow Arne Schirmacher's distinction and identify this as the "interested public" (level IV in his ranking [14]).

Adam Sedgwick the Theoryphobe

The *Liverpool Mercury* agreed with the *Edinburgh Review* that *Vestiges* "ties facts together very loosely, and seeks to draw astounding deductions from it", and sheds some doubt on the trustworthiness of his sources. Nevertheless it suggests that the reviewer has been too harsh. Whereas Sedgwick lamented the very popularity of the work, the *Mercury* considers the attention "well-deserved".

If Sedwick accused the author of Vestiges of superficiality and arrogance, then *Mercury* accuses Sedgwick of being *theory-phobic*, or of going too far in the direction of tentativeness, not being brave enough to follow the inductive process to its conclusion:

[10] £2.65 today [12]. Note that in pre-1971 currency, £1 was 240 pence

[11] The welfare of the people is the supreme law

> If Columbus had published his Theory of the Discovery of America in a pamphlet, the Rev. Professor would have demolished it in a good set speech, or a lengthy review, and would, no doubt, have blandly told him, in such language as he has used to our author, that he had no "right to toss out his fantastical crudities before the public, and give himself the airs of a legislator over the material world." In short, our reviewer is a man of talent, not of genius, nor, as a consequence, can he either tolerate or understand that higher state of mind, which with instinctive boldness, at once takes possession of a truth beyond the limits of his own mental ken
>
> — [10]

In other words, this elite geologist and member of the Royal Society is being depicted as being small-minded, and lacking a certain "instinctive boldness". The *Mercury* sets up a clear dichotomy between the "reading and thinking public" and the "schoolmen" of the Geological Society, of which Adam Sedgwick is a member.

The hypocrisy of the 'schoolmen'

According to the *Mercury*, the *Nebular Hypothesis* is attacked by Sedgwick not because of what it says, but because of who is saying it. Here we must mention that before *Vestiges*, Victorian England mainly associated the Nebular Hypothesis with the astronomer-turned-popular-science-author John Pringle Nichol [15], from whom Chambers is also likely to have learned it:

> Most geologists of any note have, in a greater or less degree, adopted it. Dr. Mantell gives us representations of nebulae, in a variety of stages of condensation, at the commencement of one of his works on the science. Dr. Buckland tells us, in one of the Bridgewater Treatises, that "the nebular hypothesis offers the most simple, and, therefore, the most probable theory respecting the first condition of the material elements that compose our solar system." (Vol. I. p. 40). There are other parts of their writings that would strongly tempt us to suppose, had it not been for the recent correspondence, that, to a great extent, they also, at least up to a very recent period, had agreed with the author of the "Vestiges" even in the theory of the progressive development of animal and vegetable life. But seeing they have now written so unmeasuredly, that they thoroughly repudiate the doctrines of the book, we are compelled to assume we have been wrong, though their works are before us.
>
> It is, however, not a little curious, that while the nebular theory was locked up from vulgar eyes in the iron-bound casket of the *Philosophical Transactions*, it was held as a talismanic gem of the first water, destined to be the key that was at no remote day to open to our gaze many of the profounder secrets of nature. But no sooner had Nichol[12], with more of zeal for popular information than proper veneration for philosophical profundity, transferred it, brilliantly re-set, to his pert little duodecimo, than it was discovered that the gem contained some flaws, and, although it had passed through the hands of such men as the elder Herschell, Laplace, and Comte, still it had diminished in value. But even after all this, our philosophers yet condescended to use sly slices of it, dexterously detached, even from the setting of Nichol, whenever they found themselves in a cosmogonal "fix." But now that the author of the "Vestiges," in his turn, has taken it, cut and dry, from Nichol, and while he has been laudably endeavouring to make it work out its seeming destiny in his own pages, it is discovered to be mere paste after all, or, in the language of our reviewer, (p. 21,) "it is a splendid vision, and may vanish in mid air."

[12] John Pringle Nichol, astronomer and popular author

After reading this quote, it is very clear that the dichotomy that the *Mercury* has set up between the "reading and thinking public" and the "schoolmen" is one of misaligned interests. The "schoolmen" are depicted as haughty, considering the reading public as "vulgar", and hypocritical, throwing away a theory when it is not expounded by "one of them" showing the adequate degree of "philosophical profundity". On the other hand, the *Mercury* appears to side with those men like Nichol and Chambers whose priority is the "popular information" rather than the "proper veneration for philosophical profundity". In other words, the *Mercury* is accusing Sedwick and his fellow schoolmen of hypocritical gatekeeping.

This hypocricy either means that "schoolmen" were afraid that the vulgar public could not handle the truth, or else that as soon as they heard their theory articulated in a popular way they changed their thinking on the manner. Either way it is a striking example of the co-creation of knowledge.

The fear the charge of materialism

The Mercury strongly disagrees with Sedgwick in calling *Vestiges* "materialist", saying that his philosophy has "for its primal object, to show us not only the universality of His outward and visible power, but that it exists in essence, undiminished through myriads or an infinitude of years".

If anyone can be accused of materialism, the *Mercury* argues, it is the "the school our Reverend reviewer so stoutly represents". We won't go into the full argument, but in short it appears that Sedgwick's conception of the Creator is inferior to that of the *Vestiges*, as the creation of planets, stars, moons, life, and species requires specific acts of divine intervention. In other words: "He must have his timepiece wound up periodically".

he Mercury takes a final, cynical swipe at the establishment's motives, suggesting that the "Schoolmen" are engaged in a performive act of scientific gatekeeping to save their own reputations.

The review argues that Sedgwick and his peers are not being entirely honest when they brand Vestiges as "rank materialism." Having spent years facing their own accusations of heresy from the high-church orthodox for their geological findings, these elite scientists were now eager to prove their own piety. By throwing an anonymous, popular author under the bus, the Mercury suggests, the scientific elite were attempting to "wash their hands" of the logical—but socially dangerous—conclusions of their own research, using Chambers as a convenient sacrificial lamb to regain favor with the religious establishment.

Ab Intra vs Ad Extra: Two conceptions of God.

The Mercury provides a concise summary of the conceptual clash regarding the "unity" Chambers claimed for the solar system. The contributor frames the debate as a choice between two modes of Divine action. The Vestiges View (Ab Intra) says that the system was imbued at creation with all the elements of its future changes, evolving internally like a "timepiece" that does not need to be touched. The Geologists' View, is "ad extra": While accepting physical laws for inorganic matter, the establishment insisted on "repeated interpositions of the Deity" to explain the creation of life.

The Mercury contributor does not explicitly take a side in this debate, but it is clear from his earlier comments on Sedgwick's materialism that he sides with the 'ab intra' model. This suggests that even in 1845, some segments of the public found the "unity" and "law-based" cosmology of Vestiges more palatable on theological grounds than the "ad extra" model held by professional scientists.

Atlas

The Atlas review appeared in December 1845 and is technically a review of the sequel to *Vestiges*, *Explanations*. It reiterates some of the criticisms in the *Edinburgh Review*, such as the fact that more powerful telescopes had found these nebulae to consist of point stars, and the difficulty of accounting for the amount of angular momentum in the solar Moreover, it takes a firm stand against its speculative quality:

> Science had made great acquisitions, and it seemed desirable, if only for experiment sake, to see what kind of Frankenstein would result from the architectural union of her scattered limbs

Examiner

One question we have circled but not explicitly stated is whether theology can accomodate this new version of how things came to be. The Examiner engages with the Nebular Hypothesis on these terms, arguing that while it will take time, it fundamentally does not have an issue with theology.

On the other hand, the Examiner takes a more positive tone in the review. It praises the author for his wisdom and beneficence - rather than engaging with all the controversial arguments it makes a point that controversy, even where it may appear contrary to received opinion, is welcome - provided it can be shown to be true in due course; The Examiner expresses a faith that all hypotheses in the Vestiges will turn out to be compatible with Victorian morality, given enough time. I suspect that this is revealing about the type of Victorian morality The Examiner is a defender of

Conclusion

The debate over the Nebular Hypothesis was not merely a technical disagreement about astronomy; it was a visible "fault line" in Victorian society, revealing deep anxieties about who has the authority to define the natural world and the role of the Creator in a law-governed universe.

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