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NOTE

HEGEL AND THE SEVEN PLANETS

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In the Copernican system, Earth-based observers were able to derive the radii of the planetary orbits in terms of the (mean) Earth–Sun distance, from observation and elementary trigonometry. Before the end of the sixteenth century, Kepler had been struck by the disproportionate gap between the orbits of the fourth planet, Mars, and the fifth, Jupiter, and had considered the possibility of filling the gap with a planet hitherto unobserved.[1] Although Kepler eventually found an alternative way of dealing with this apparent anomaly in the planetary system, other astronomers continued to feel uncomfortable with the system as presently understood, and the formulation in the last quarter of the eighteenth century of the arithmetical relation known as 'Bode's Law' served to bring matters to a head.[2] In this Law, the distances from the Sun of the six known planets were seen as roughly proportional to the numbers 4, 4+3, 4+2.3, 4+4.3, 4+16.3 and 4+32.3, but no known planet corresponded to the term 4+8.3. The Law received unexpected support from the discovery by William Herschel in 1781 of the planet Uranus, whose solar distance corresponded well with the next term in the arithmetical sequence, 4+64.3; and at the close of the century Franz Xaver von Zach and others joined forces to organize a systematic search[3] for the supposed missing planet between Mars and Jupiter corresponding to the term 4+8.3.

On 1 January 1801, before the invitation to join in the search had had time to reach him, Giuseppe Piazzi of Palermo discovered a planet (or, more exactly, what was to prove a very small but otherwise planet-like body) that was found to have an orbit of the appropriate size.[4] But news of the existence of this eighth planet (now known as the asteroid or minor planet Ceres) had barely had time to reach Germany when the young philosopher Georg Wilhelm Friedrich Hegel (1770–1831) published his docent thesis, *Dissertatio philosophica de orbitis planetarum*.[5]

Hegel is commonly ridiculed by historians of astronomy as having 'demonstrated' the impossibility of there being an eighth planet at the very moment that an eighth planet was being discovered. So for example we read that in the dissertation Hegel "proved by the clearest logic that the number of planets could not exceed seven",[6] or again, that Hegel " 'logically proved' that the number of planets could not exceed seven".[7] Indeed, so frequently is Hegel castigated for this that a recent writer felt compelled to follow custom:

> ... pour nous conformer à l'usage, nous ne manquerons pas de rappeler que c'est dans l'intervalle de temps assez long séparant la découverte de

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> Piazzi du moment où elle fut connue en Allemagne que Hegel publia [sa thèse] dans laquelle il démontrait qu'il ne peut exister plus de sept planètes.[8]

It is sad to have to call in question such a pleasing tale, but in fact Hegel does no such thing. These authors can only be referring to the short Section III of *De orbitis planetarum*, for nothing else in the dissertation could possibly be thought to bear on this question. The search therefore narrows to a page and a half, which makes it easy to establish there is no such "proof". In the first place, Hegel is not here concerned in any way with the total number of the planets, but only with whether there is a planet, yet to be discovered, between Mars and Jupiter. Now had he "proved" that there could not be one, just as its discovery was being confirmed, at least the spirit of the anecdote would have been preserved, though not its letter. But again the facts disappoint. For what we find is no proof that the gap between Mars and Jupiter must be empty, but only a criticism of the argument that was leading contemporary astronomers to think that it was likely to be occupied. Hegel cites another series (one not without a certain philosophical pedigree, as he points out) that roughly matched the orbits of the then known planets, but unlike Bode's Law did not have any term that corresponded to an apparent gap in the solar system. The criticism is fair, and it is not made any the less fair by the fact that, as it happened, Bode's Law came up trumps. We all know that a weak argument can turn out to have a true conclusion; in which case those who believed the conclusion may be allowed a little quiet enjoyment of their luck, but nothing like the hearty laughter that would have been due had Hegel really done what has come regularly to be attributed to him. To do that, however, he would have had to say that his "more philosophical" series was actually the right one. And the passage shows no sign of any such claim, only: "*If* this series *should be* the truer order of nature ..." ("Quae series si verior naturae ordo sit ...").

APPENDIX

The following is a translation (kindly supplied by Dr G. D. Williams of Churchill College) of the opening paragraphs of Section III of the thesis:

It remains for me to add to these observations some remarks about the numerical relation of the distances between the planets. It seems that these distances belong to the domain of only experimental knowledge. But the measured proportions and numerical order of nature cannot but be related to a rational scheme; and the study and understanding of the laws of nature rest solely on our belief that nature is shaped out of a rational scheme and on our persuasion that all the laws of nature are consistent. There are those who try to find these laws through experimentation and inductive thinking. When they chance to stumble upon what looks like a law, they acknowledge that consistency between a rational scheme and nature in such a way that they rejoice in their discoveries; and if any other phenomena are not quite in full accord with that oneness, they express doubt about their experiments and take pains to establish the harmonious relationship of each [*sc.* the rational scheme and nature] in every way. The numerical relation of the distance between the planets which I mention provides a case in point. For since the distances between the planets yield a certain numerical relation based on an arithmetical progression, but there is no planet in nature to answer to the fifth leg of that progression, it is assumed that a planet which is unknown to us actually

exists between Mars and Jupiter and roves through the heavens — and that planet is assiduously sought after.

Since this progression is arithmetical and follows not even the multiplication of numbers by themselves (i.e. the powers), it has nothing to do with philosophy. It is well known how much the Pythagoreans worked out in the philosophical relations of numbers; and hence we may apply the series of numbers set down and preserved in both versions of the *Timaeus*. *Timaeus* does not apply these numbers to the planets, but reckons that the Demiurge shaped the Universe according to the schematic relationship of those numbers. The series of numbers is 1, 2, 3, 4, 9, 16, 27; for instead of the 8 which we read, we may posit 16. If this series should be the truer order of nature than that arithmetical progression, it is apparent that there is a great gap between the fourth and fifth places, and that no planet is wanting there.

[Hegel then concludes this brief Section by discussing the distances of the satellites of Jupiter and of Saturn.]

REFERENCES

1. J. Kepler, *Mysterium cosmographicum* (Tübingen, 1596), 7: "Inter Iouem & Martem interposui nouum Planetam ...."
2. On the history of Bode's Law, see in particular Michael Martin Nieto, *The Titius-Bode Law of planetary distances* (Oxford, 1972).
3. F. X. von Zach, "Über einen zwischen Mars und Jupiter längst vermutheten, nun wahrscheinlich entdeckten neuen Hauptplaneten unseres Sonnen-Systems", *Monatliche Correspondenz*, iii (1801), 592–623, pp. 602–3.
4. *Ibid.*, 604–5. For a modern account of this well-known episode, see for example the entry on Piazzi in *Dictionary of scientific biography*.
5. G. W. F. Hegel, *Dissertatio philosophica de orbitis planetarum* (Jena, 1801), reprinted in *Georg Wilhelm Friedrich Hegel Sämtliche Werke*, ed. by G. Lasson, i (Leipzig, 1941), 347–401 (with German translation).
6. Morton Grosser, *The discovery of Neptune* (Cambridge, Mass., 1962), 32.
7. Nieto, *op. cit.*, 17–18.
8. Jacques Merleau-Ponty, *La Science de l'univers à l'âge du positivisme* (Paris, 1983), 129.